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The Genus *Notonecta* of the World

(Notonectidæ-Hemiptera)

H. B. HUNGERFORD,

Head of Department of Entomology, University of Kansas, Lawrence.*

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Abstract: This paper is the result of studies covering a number of years and visitations to many important museums of Europe and North America. All species are redescribed and most of them are illustrated in color. Besides five color plates there are twelve plates in black and white, illustrating structural parts of taxonomic interest. Keys to the species of each hemisphere are included.

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INTRODUCTION

It is now twenty-nine years since the appearance of G. W. Kirkaldy's [47] "Uber Notonectiden," which concluded his studies on the Notonectidæ of the world, and thirty-six years since his "Revision of the Notonectidæ, Part I," [45] was published. It was in this last-named paper that Doctor Kirkaldy reported his studies upon the genus Notonecta. In the years that have intervened between that time and the present some species have been described as new and structural characters of specific value discovered that are much more precise than those known to him. I believe, therefore, that it is time to assemble our knowledge of this genus, and, if possible, stimulate a wider interest in this group. Surely there are species not yet taken or recognized as new, and more intensive collecting and closer scrutiny will prove fruitful indeed. There are vast areas where the terrestrial insect fauna is quite well known from which the aquatic collections are very meager. This is due in large measure to the fact that the equipment necessary for thorough water collecting is somewhat different from that employed in the capture of terrestrial insects. While much interesting material could be taken with the ordinary land nets, collectors are loath to dampen their equipment. A little more attention to water insects by the general collector would be amply repaid.

In passing in review the literature that has dealt with the Notonecta of the world we find just two papers of length—Fieber's "Rhynchotographieen," [30] 1851, and Kirkaldy's "Revision of the Notonectidæ," [45] 1897. These papers were preceded by the following, which paved the way: Linnæus in his tenth edition of "Systema Naturæ," 1758, erected the genus Notonecta and placed in it three species, *N. glauca*, *N. striata* and *N. minutissima*. The last two were later removed to other genera. Leach in his "Classification of Notonectides," [51] 1817, proposed a new genus Plea, and Spinola in his Essai,[79] in 1837, brought out the genera *Anisops* and *Enithares*.

In Fieber's paper a number of new species were described and many varieties proposed on the basis of size and color alone. Thus only in those cases where the types are extant can Fieber's species be fixed with satisfaction. His casual disposition of previously described species is well illustrated by his treatment of Amyot and Servilles *Notonecta mexicana*. After describing *N. klugii* he remarks that *N. mexicana* "dürfte wohl nur eine varietät der oben beschriebenen *N. Klugii* sein, oder zur folgenden gehören" (his own *N. impressa*). A further problem in nomenclature arises from this author's treatment of specific names. For illustration: He describes *Notonecta variabilis* in three lines and then names and describes four varieties, citing the habitat of each; the first variety, *N. scutellaris,* from Brazil and Porto Rico, the second, *N. maculata,* from Baltimore (U. S. A.), and the third and fourth varieties from Brazil. Since two or more species are involved, it is necessary to consider his first-named variety as his *N. variabilis* and its locality as the type locality.

In Kirkaldy's paper, which appeared nearly fifty years later, the author made an honest and worthy effort to set in order the taxonomy of the genus Notonecta. He appears to have made every attempt to locate and examine types and to gather together all the material he could command. His types have been designated and preserved. He introduced some structural characters and brought some order out of the chaos. His allowance for wide variability in some species, has, in some cases, been too great, giving an unwarranted distributional range for such species. For example, he did not note the specific differences between the common North American *Notonecta undulata* Say and a much smaller species in Chile.

In this, the third general study of the genus, I have gone to the sources both for descriptions and types as far as they have been available to me. I have tried to account for every named species, but there are some descriptions without existing types or without material from type localities that fit the descriptions which are often too brief. Whether the descriptions are inaccurate, or whether the species in question have not been seen by me, I cannot say. Most of the older descriptions are based on color and it is almost impossible to appropriate them with any degree of certainty. This paper has been in progress for twelve years and publication withheld in the hope that every case might be clarified. I find that the time has come when I must present my results, such as they are, hoping that the future may uncover points now obscure to me. The colored figures so faithfully drawn for me by Miss Kathleen Doering will enable anyone to determine the specimens in the catch that are fully and typically colored. The teneral forms and the bichromatic species may be perplexing. In such cases note the size, shape of the head, thorax, mesotrochanters, abdominal sternites and genitalia. Kirkaldy[45] made a significant contribution to the taxonomy of the Notonecta when he introduced the more or less precise measurements of the head. Champion, 1901, in the Biologia Centrali Americana (Hem.-Het., Vol. II) noted the fact that certain species have the ventral abdominal keel bare, while others have this keel covered with hair. Delcourt's [22] study of the biology and pigmental variations of the forms of his region have been helpful; indeed, he demonstrated the value of biological facts in establishing his *N. viridis* as a distinct species. Edwards [25] in describing his *N. halophila* (now known to be *N. viridis* Delcourt) called attention to the anterolateral angles of the prothorax.

In 1917, while studying the biology of some species of Notonecta in New York state, I discovered that the female gonapophyses have some specific characteristics.[37] A little later I[39] investigated the value of the male genital capsules and found them to be quite precise and satisfactory in specific determination. An examination of long series of a given species taken from widely separated places in the United States has demonstrated the fixed characters of the male genitalia. Since that time I have submitted drawings of the genital capsules of the species that I have described, and other workers have used the male genital characters in taxonomic problems with success.

In 1922 R. Despax [24] made a study of *Notonecta maculata* Fabr. and *Notonecta glauca* L. and figured the genitalia. In 1924 Raymond Poisson [65] figured the male claspers of *Notonecta furcata, Notonecta glauca, Notonecta maculata* and *Notonecta viridis* Delcourt and demonstrated their specific differences. He writes: ". . . les différentes pièces de l'armature génitale, dans chacune des espèces, conservant une structure constante." More recently this last author [66] has compared the three species common to his country and Asia Minor. His drawings show general resemblance in each case. Esaki (1927), in describing his *N. horvathi* (= *N. pallidula* Poisson, 1926), compared the direction and relative length of the lateral margin of the pronotum of this species with that of *N. glauca* Linn., and in his recent description of *N. saramao* Esaki he has attempted to state precisely in degrees the anterolateral angles of the pronotum.

Another character that I have found to be of value in separating certain confusing species is that of the mesotrochanter.[40] In some species, the majority, indeed, it is rounded, but in others it is angulate or even spurred. The shape of the sternites of the abdomen are often specific, and the last abdominal sternites of the females are especially useful. The characteristic shape of the head and thorax often defy a word description, yet are sufficiently distinctive to identify a species. The sexes are sometimes of different color, as, for example, the males of *Notonecta lobata* Hungerford, which are usually black, while the females are red. They may also be of somewhat different shape. The head and thorax, for example, of Kirkaldy's *Notonecta ceres* are quite unlike in the two sexes (see Color Plate III, figures 2 and 3). The males are, in many species, slightly smaller and the distance between the eyes slightly less, relatively, than in the females. In every case of doubt an examination of the quite precise characters of the male genital capsule will settle the question of specific identity.

FAMILY CHARACTERISTICS

The Notonectidæ embrace perfectly aquatic forms differing from all others (except the Pleidæ and Helotrephidæ formerly included in this family*) in the persistent habit of swimming on their backs. They are deep-bodied, convex dorsally and more or less triangular in cross section. The eyes are large, reniform, and twice sinuated on the outer side. Ocelli are absent. Antennæ with three or four well-defined segments and partly concealed between the head and thorax. Beak four-segmented. Front and middle legs adapted for grasping and hind legs more or less flattened and fringed for swimming. Tarsi two or three segmented (counting a small basal segment). Two tarsal claws present in all, but inconspicuous on the tarsi of the hind legs. Scutellum visible. Abdominal venter with median longitudinal keel provided along the lateral margins at least with guard hairs, which, together with movable rows of similar hairs from the sides of the venter, are capable of closing over the two longitudinal troughs thus forming air chambers.

I propose to arrange the genera of the family as now restricted as indicated in the key which follows:

KEY TO GENERA OF NOTONECTIDÆ

A. Hemelytral commissure without pit at anterior end............(Subf. NOTONECTINÆ.)
B. Intermediate tarsus with two well-developed segments and a very small basal one. Intermediate femur stout with anteapical pointed protuberance. (Tribe NOTONECTINI.)
C. Anterolateral margins of prothorax not foveate.................*Notonecta.*
CC. Anterolateral margins of prothorax foveate. (See Pl. VI, fig. 2)...*Enithares.*
BB. Intermediate tarsus with one well-developed segment and the middle femur without anteapical pointed protuberance.......................(Tribe NYCHINI.)
C. Antenna 4 segmented....................................*Martarega.*
CC. Antenna 3 segmented....................................*Nychia.*
AA. Hemelytral commissure with pit at anterior end.† (See Pl. VI, fig. 7.) (Subf. ANISOPINÆ.)

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* These two families forming the superfamily Pleoideæ Esaki and China are distinguished from the Notonectoideæ by having hemelytra thick and united apically. Ventral abdominal segments may be medianly tuberculate but not carinate.

† Poisson[68] 1926 considers this a sensorial organ in *Anisops producta* Fieb.

B. Ventral keel not extending onto last abdominal segment. Male genital capsule cleft behind. Males without stridulator protuberance on front tibia. Females with short gonapophyses.......................................*Paranisops.*

BB. Ventral abdominal keel extending onto last abdominal segment. Male genital capsule closed behind. Males with stridulatory protuberance on front tibia. Females with elongate subspatulate gonapophyses.

- C. Male with anterior tarsus 1 segmented..........................*Anisops.*
- CC. Male with anterior tarsus 2 segmented..........................*Buenoa.*

The above arrangement is new, but appears to me to be more logical than any proposed thus far. Kirkaldy,[45] 1897, divided the family into Notonectinæ and Pleinæ. Hale, 1923[32] and 1924,[33] followed Kirkaldy, as did Hutchinson,[41] 1929. Esaki and China,[28] 1928, removed Plea from the Notonectidæ and revived the family Pleidæ first erected by Fieber under the name Pleæ. They made the following disposition of the groups formerly embraced by the family Notonectidæ:

Superfamily Notonectoideæ for the family Notonectidæ.

Superfamily Pleoideæ for the families Pleidæ and Helotrephidæ.

Hutchinson,[41] 1929, proposed to divide his Notonectinæ into the tribes Notonectini and Anisopini, the first embracing Notonecta and Enithares and the second Nychia, Anisops, Buenoa, and Paranisops. He did not undertake to place Martarega B. White and Signoretiella Berg, but suggested that a third tribe might have to be instituted for them.

There seems to be no good reason for separating Nychia from Martarega. These two genera belong in the same tribe. They agree in general facies, both have eyes contiguous at base; both have the face transversally depressed; both have a curious curve in the costal margin of the hemelytra; both have male genital capsules that are cleft behind.[*] In every way save one they are quite alike. Nychia has a three-segmented antenna and Martarega a four-segmented antenna. However, it is conceivable that Nychia has lost the fourth segment by atrophy since it is small and loosely joined in Martarega. They are indeed closely related genera and belong in the same tribe.

Whether Enithares is closer to Notonecta than to the Nychia-Martarega group is a debatable question.[†] It shares some characters with one and some with the other. It is like Notonecta in having the eyes well separated, in having middle femora stout and

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[*] Doctor Jaczewski,[42] 1928, in his "Notonectidæ from the State of Paraná," p. 132, describes the genital capsule of Martarega.

[†] Doctor Jaczewski,[43] in Notes on Some West-African Heteroptera," 1926, p. 78, places it with Notonecta, and I concur with him in this opinion.

equipped with an anteapical proturbance, in having the claspers of the male genital capsule in most species alike,‡ in having the same number of tarsal segments (two well-developed segments and a very small basal one in the front and middle legs).

On the other hand it has the anterolateral margins of the prothorax foveate like Nychia and the shiny surface and texture of the hemelytra. The ædeagus is unlike Notonecta.

As a matter of fact it would seem to me that a cytological study of these various genera might throw some light upon the problem. A little work has been done on Notonecta and has been of real value in understanding relationships within the genus.

In the above key the genera are arranged in phylogenetic order beginning with Notonecta, the most primitive genus, and progressing to the highest. No linear arrangement is consistent in all regards. The best one can do is to use the most fundamental differences and allow for parallel and independent modifications. For example, the ovipositors of Notonecta females may be short and weak or long and strong.

The genus Notonecta embraces 63 species, 14 subspecies, and is widespread over the earth. There is one species in Australia, one in Africa south of the Sahara, several in Asia, several in Europe and North Africa, 25 in North and Central America and 20 in South America. The genus Enithares, with a single exception (*E. brasiliensis* Spinola from S. A.) is found in the Eastern Hemisphere only. Nychia belongs to the Eastern Hemisphere and has its counterpart Martarega in South America. Anisops is widely distributed over the Eastern Hemisphere and is replaced by Buenoa in the Western Hemisphere. Paranisops is confined to Australia.

From the standpoint of distribution alone, Notonecta might be considered the oldest genus. This consideration, however, is supported by the four segmented antennæ, by the three segmented tarsi and by the lack of asymmetry in the male genitalia. Enithares, as stated above, comes next. It is the only other genus represented in both Hemispheres. Its only representative in the Western Hemisphere is a very large species which has the male genital claspers unlike. So far as I know all of the other species in the genus lack this asymmetry.

In some regards Enithares may be more primitive than Notonecta. The interocular space shows less variability than in Notonecta. The female gonapophyses are uniformly weak, and Hale[32] has reported that "Enithares commonly anchors itself to submerged objects, even walking up a plant stem to the surface for a renewal of its air supply." While species of the genus Notonecta anchor themselves to submerged objects, I do not recall having seen them climb supports to the surface. Nevertheless the foveate anterolateral margins of the prothorax, the shiny surface and the beginnings of asymmetry in the male genitalia anticipate the Nychini.

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‡ *Enithares braziliensis* Spinola has the right and left claspers unlike. (See Pl. VIII.)

Nychia and Martarega have the male claspers unlike on the two sides. In Martarega the claspers are the less differentiated. Nychia has lost the terminal antennal segment. The increasing unlikeness of the male claspers and the three segmented antennæ of Nychia approach the condition in the Anisopinæ. The Nychini usually have the flight wings reduced, accompanied by a small scutellum. When fully developed flight wings are present, the scutellum is large. This is true also of Paranisops, which belongs in the Anisopinæ, and is the most primitive of that subfamily.

I consider the Anisopinæ at the top of the series because: (1) They have oxyhæmoglobin and a pit on the anterior end of the commissure of the hemelytra; (2) the males possess stridulatory organs and a courting ritual (excepting Paranisops); (3) the antennæ are three-segmented; (4) in Buenoa and Anisops the female gonapophyses are uniform and long. The male genital capsule is closed behind and the claspers decidedly unlike on the two sides. The genitalia in these last two genera have reached such a stability and uniformity that they are of little value for purposes of specific determination.

The Anisopinæ are more at home in the open water, cruising about gracefully and in perfect equilibrium at some distance beneath the surface.

Besides the differences stated in the key the Notonectinæ and Anisopinæ are unlike in the character of the labrum.*

ANATOMICAL NOTES, TECHNIQUE AND TERMINOLOGY

A number of contributions have been made to our knowledge of the anatomy of the backswimming water bugs. Wefelscheid,[83] 1912, produced a study, "Uber die Biologíe und Anatomie von Plea," that is monographic in nature. Esaki[28] and China investigated the Helotrephidæ. In the Notonectidæ as now restricted Buenoa has been studied by Bare[4] and Anisops by Poisson.[68] Notonecta has been the object of many studies, for the most part in connection with some general problem dealing with mouthparts, wings, respiration, or genitalia. Some studies on embryology and cytology are also available. Several of these have considerable value to the systematist. Hutchinson,[41] in his "Revision of the Notonectidæ and Corixidæ of South Africa," figures the venation of the hind wings of Notonecta, Enithares, Nychia, Anisops and Plea. Specific differences in the ovipositors of American Notonecta (1918)[37] and in the genital capsules of the males (1919) were reported by Hungerford.[39] Since then the genitalia have been used in systematic papers by Hale, Jaczewski, Bare, Hutchinson, Despax, Poisson and Esaki.

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* Except Paranisops which has labrum like Notonecta. Paranisops also has infracoxal plates hairy like Notonecta.

Hutchinson, in the paper cited above, employed the cytological evidence in chromosome studies made by Browne,[16] in 1916 and by Poisson [69] in 1927 in his division of the genus Notonecta into the subgenera Notonecta S. Str. and Paranecta (new); the latter embracing *Notonecta lactitans* Kirk. and all the other species without digitiform extension of the male genital capsule and with short ovipositors in the female; the former, with *Notonecta glauca* L. as the type, and including species in which the males have the digitiform extension of the male capsules and elongate ovipositors. Hutchinson believes that the subgenus Paranecta is the older group because of the less specialized condition of the ovipostor, the simpler genital capsule and the larger number of chromosomes. Browne found that in *N. undulata* Say, *N. indica* Linn. (= *N. unifasciata* Guér. probably) and in *N. shooteri* Uhler, the diploid number of chromosomes is 26, the first spermatocyte division showing 14 (the sex chormosomes conjugate late) and the second 13.

In both *N. Glauca* Linn. of Europe and *N. irrorata* Uhler of North America the diploid number is 24, the first spermatocyte division showing 13 and the second 12. It would be very helpful if further cytological studies in the Notonectidæ were made.

The *Notonecta mexicana* A. & S. series, for instance, could be studied with profit. This group is in some respects quite distinct, and certain species such as *Notonecta lobata* Hungerford could be secured in large numbers in the southwestern United States. A study of *Notonecta handlirschi* Kirkaldy, which was placed in the new subgenus Enitharonecta by me in 1928,[40] should be made and compared with a study of some species of Enithares. Unfortunately we must first discover the breeding place of this unique Australian representative of the genus Notonecta. So far we know it only from the two specimens of the type series in the Vienna Museum which are labeled "Post., A. Fischer, 1878," and one other specimen.

In this paper it is necessary to present only such gross anatomical features as may be useful in the separation of the species. The illustrations on Plates VI, IX and X will give an idea of the chief anatomical characteristics of the genus Notonecta.

In understanding the descriptions given in this paper it is important to note that the measurements have been made from above the dorsal side of the insect when held in a horizontal position. Care must be taken to have the longitudinal and transverse axes exactly horizontal. The length of the head, compared to median length of pronotum, has been determined by projection and not by tilting the insect out of position; so, also, in comparing length of vertex with its anterior width and the convexity of the anterior margin of the vertex with that of the frontal margin of the eye. The ratio of the anterior breadth of vertex to the synthlipsis is secured by measuring the distance between the eyes in front and the narrowest interocular space, the latter being called "synthlipsis."

The lateral margins of the prothorax are always more or less compressed dorsoventrally into a more or less thin edge, or ledge, which in some species is quite broad along the anterior portion. By viewing this edge from the side it is usually seen to be somewhat sigmoid, and, compared with the long axis of the insect, is either oblique or nearly parallel with it. The shape of this ledge may be quite different in the sexes of the same species.

The abdominal sternites are often of interest (see Plate X). In some species the edge of the mid-ventral keel is bare on one or more segments. The so-called "fourth abdominal sternite" is so designated for the convenience of the taxonomist. It is really the sternite of the fifth segment. In the females the shape of the last two abdominal sternites* afford excellent characters (see Plate X). In the *N. mexicana* A. & S. series the penultimate sternite is very narrow, in *N. montezuma* Kirk. it is long, broad and keel is bare; in *N. undulata* Say it is relatively long and cleft behind, while in *N. irrorata* Uhler it is broader than long. The last abdominal sternite is no less interesting. On Plate X I have figured four distinct types. Figure 1 illustrates the characteristic shape of the *N. mexicana* A. & S. series, figure 3 the usual shape of the subgenus *Paranecta* Hutchinson, and figure 4 that of the subgenus Notonecta. In Paranecta the first pair of gonapophyses are short and in Notonecta they are elongate.

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* Also referring to those visible as the fifth and sixth. Of course they are actually the sternites of the sixth and seventh and the three pairs of gonapophyses are attached to the eighth and ninth. The genital capsule of the male belongs to the ninth segment.

The male genital capsules with their claspers or parameres afford good characters. There are three distinct groups of the genus based upon the shape of the capsule itself. The subgenus Enitharonecta, with its caudal projection and reduced lobes behind the claspers (see Plate VIII, fig. 4); the subgenus Paranecta, which lacks a digitate process (see Plate XIII); and the subgenus Notonecta, which possesses such a process (see Plates XVI and XVII). The male genital capsule is hidden within the last abdominal segment and must be drawn out into view, and for careful study must be cleared. Both operations are quite simple after a little practice. To remove the capsule moisten the insect with 5 per cent alcohol to relax it. After a few minutes hold the insect between thumb and finger of one hand and with the other, by means of a dissecting needle bent at the tip, reach in and bring out the capsule. It is often best to slip the needle in between the body wall and the capsule on both sides to loosen the connections before undertaking to draw out the capsule. To clear the capsule place it in caustic potash solution and either boil it for a time till clear or let it stand in the cold solution two or three days. I prefer the latter method. After washing the cleared capsule in water it can be studied under the binocular and then stored in a vial of alcohol (70 per cent) or dehydrated with alcohol, placed for a few minutes in xylol and mounted in a drop of balsam on a card or celluloid slip to be placed on the pin beneath the insect. Another method that is even better is to clear a little, wash in water, then place in a little dish of acetic acid. After ten minutes add a drop of clove oil, adding clove oil drop by drop every few minutes, and drawing off the excess with a pipette. After a time the capsule will be in pure clove oil, from which it can be mounted directly in a drop of balsam on a celluloid card for pinning beneath the insect. If the insect is then placed in a dust-free chamber until the mount hardens, this method will be found most satisfactory.

The ædeagus† also should be examined and the amount of clearing of the genital capsule must be enough to enable a study of the claspers and yet not enough to destroy the characters of the ædeagus, which in certain cases are useful. The difficulty in securing uniform clearing so that precise comparisons of scleratized parts can be made and the wide differences in the relative positions of the parts of the ædeagus in different individuals has led me to omit specific descriptions of this structure. The structure, called the "internal stay" by Hutchinson[41] (see his Plate XXVIII, fig. 2), appears to be most developed in the *N. mexicana* A. & S. group and but slightly developed in the *N. lutea* Müller group.

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† Phallic organ, according to Snodgrass.

THE BIOLOGY OF THE NOTONECTIDÆ

The backswimmers are among the best known of the water bugs. They inhabit the ponds and pools of nearly every land. The fact that they swim on their backs readily distinguishes them in their native element. They are predaceous creatures, the larger species often attacking insects and other animals, even small fish, larger than themselves. The small nymphs of Notonecta and probably all of the Anisopinæ, even in the adult stage, feed to a large extent upon the small Entomostracan life of the water.‡ The Anisopinæ have the two anterior pairs of legs margined with rather long spines, which form, when flexed, a splendid crib for the retention of ostracods, cladocera, etc., many of which may be held captive at one time.

Members of the genus Notonecta, and no doubt of the Enithares§ also, can inflict a severe "sting" with their beaks when incautiously handled, a fact which led to the use of the name "Wasser-bienen" by the early German writers. This disagreeable behavior has given them a place in the literature of Medical Entomology (see Riley and Johannsen Handbook of Medical Entomology). No doubt most of the observations in this regard have been made by collectors, but on several occasions I have been impressed by their reputation as "stingers" and their economic importance to the owners of commercial swimming pools. Instances have been reported to me in which the swimming pools have been so infested with these insects and the complaints so numerous among bathers that the elimination of the backswimmers became necessary to restore the popularity of the pools.

Most species winter as adults either hidden in the mud and other debris of the pool or remain more or less active as conditions may permit. They have been observed swimming beneath the ice in spring-fed pools in midwinter. There is some evidence, mostly unpublished, to indicate that certain species may also overwinter in the egg stage.* Some species have been observed to leave the shallow temporary pools of summer to fly to deeper waters in which to winter.

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‡ Anisops and Buenoa can be and have been reared in captivity upon mosquito wrigglers.

§ H. M. Hale in the Records of the South Australian Museum, Vol. II, No. 3, 1923, reports the "sting" of Enithares as similar to that of a bee sting.

* See under *N. lutea* Müller and *N. borealis* Bueno and Hussey.

There are some interesting records of countless swarms of Notonecta that for some reason have been precipitated from their flight in mid-air to drop like hail upon the ground. One such "rain of insects" recorded in the northern United States in 1846 covered an extent of at least twenty-five miles in one direction.

Sometimes Notonectidæ fly to trap lights, and Mr. R. A. Stirton, who collected these insects for me in Central America, drew them within reach of his net by the use of a flash light over the water.

Mating takes place in the water, and the courting maneuver of Buenoa, and probably most† other Anisopinæ,‡ includes stridulation of the males, which make a chirping sound by rubbing the front legs against the base of the beak as they approach the females. The eggs of some of the Notonecta (the majority) are affixed to aquatic vegetation and other supports in the water, while others insert their eggs more or less deeply into plant tissues. The oviposition of only one species of Enithares has been published, and this one affixed its eggs to aquatic vegetation. So far as known, all of them have the first pair of female gonapophyses short and weak and not adapted for piercing plant tissue. The Anisopinæ, on the other hand, with the exception of Paranisops, have well-developed gonapophyses and must insert their eggs as has been observed for some of the Buenoa. So far as known there are five nymphal instars, and there may be one or more generations, depending upon the species and the climate.

RELATIONS TO OTHER AQUATIC LIFE

The Notonecta are powerful swimmers, but not as fleet as the Corixids. Ordinarily they swim short distances, coming to rest back downward just beneath the surface film, the tip of the abdomen in contact with the surface, the body and head downward at such an angle that just the claws of the intermediate limbs may touch the surface and the hind limbs directed well forward of right angles to the body, poised for a sudden rowing stroke, or else they dive to cling to some submerged object. Certain species prefer open water, others the shelter of aquatic vegetation, and still others the dark, shadowy places beneath overhanging bushes. Some will live in muddy, stagnant little ponds, others only in cool, clear waters. For the most part the Notonecta live in standing bodies of water or in quiet pools of a watercourse. One species will tolerate the brackish waters by the sea, and some have been taken in the acrid coffee-colored waters of some peat-bog pool. As a group they are probably indifferent to a wide range of pH.

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† Paranisops is doubtless mute.

‡ Hale in Records of the South Australian Museum, Vol. II, No. 3, 1923, p. 406, describes the courtship and stridulation of *Anisops hyperion* Kirk. which is very similar to observations made by Hungerford and by Bare of Buenoa.

Their relation to the other small creatures of the water is that of predator. In their early stages they feed upon the small crustacea (Entomostraca mostly) and small insect larvæ; in their later stages upon larger forms, even small tadpoles and little fishes. In turn they may be taken and devoured by the naiads of dragon and damsel flies, by Belostomatids and Nepids and by predaceous water beetles. Now and then they are captured by some surface-dwelling insect or other animal. They are seldom eaten by the fishes, at least much less frequently than are the Corixids, which often dwell with them in large numbers.

Their contention for the same food* that small fishes eat and their destruction of the early stages of some of the fishes make them of some economic importance in fish culture. The economic relation of the Notonecta to the plant life of the water is trivial. Some species make incisions in the stems of plants for the deposition of their eggs, others merely attach them to the leaves and stems. While chlorophyl from Spirogyra has been found by Bare[3] in the stomachs of some Buenoa, it is not probable that the Notonecta feed directly upon plant life.

GEOGRAPHICAL DISTRIBUTION

The family Notonectidæ is represented by one or more species in nearly every land. Only one genus, however, has anything like a world-wide distribution. This is the genus Notonecta, and it has not been reported for the East Indian Archipelago, Philippine Islands, New Zealand, Tasmania, Madagascar, Hawaii or other Pacific insular groups. Furthermore there is but one species found in Australia, and this one is a curious species found only in west Australia (*N. handlirschi* Kirkaldy, known only from three specimens). It is the type of the subgenus Enitharonecta Hungerford and, as the name implies, is in some respects intermediate between Notonecta and Enithares. The other subgenera of the genus Notonecta are Paranecta Hutchinson, Bichromonecta Hungerford, Erythronecta Hungerford and Notonecta Linnæus.

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* G. C. Embody[26] records them killing amphlipods as large as themselves.

The subgenus Paranecta appears to me to be the oldest. It is widely distributed in the Western Hemisphere, having 15 species in South America and 13 species covering Insular America, Central and North America. It is then the dominant subgenus of the Western Hemisphere. In the Eastern Hemisphere we find a species, *N. lactitans* Kirkaldy in Africa south of the Sahara, but not one in Europe! In eastern Asia we find 3 in China, 1 in eastern Siberia, 1 in Japan and 1 in Formosa. The distribution suggests that the subgenus may have arisen in the new world, and that the old-world species, namely the one in south Africa, those in eastern Asia, Japan and Formosa, represent the terminals of an early dispersal. Even the subgenus Enitharonecta in remote Australia may have developed from some ancestral Paranecta.

In North America we have *N. insulata* Kirby and *N. kirbyi* Hungerford that represent a link between this subgenus and subgenus Notonecta. The former species occurs in northern United States and Canada east of 100th meridian and the latter in western Canada and western United States, ranging southward along the mountain chain. These two species, together with *N. impressa* Fieber (*N. montezuma* Kirkaldy) from Mexico and north into Texas form a distinct group of the subgenus Paranecta.

Other groups in this subgenus can be distinguished, such as the *N. bifasciata* Guérin group, the *N. undulata* Say group, and the *N. chinensis* group.

Most of the South American species are small in size and much alike and belong to the *N. bifasciata* Guérin group. The *N. undulata* Say group consists of species of moderate size and is represented in South America by *N. fazi* Hungerford in Chile, its close relative *N. vereertbruggheni* Hungerford just over the mountains to the east, and *N. variabilis* Fieber in Brazil. *N. undulata* Say is widely distributed over North America from coast to coast. In the northern half of the United States and Canada it is readily recognized in the field, but as we proceed southward into the Lower Austral Zone we find it more and more replaced by *N. indica* Linnæus, which is an abundant species, not only in the southern states but in Cuba and Jamaica and extending southward from Mexico to Colombia. *N. variabilis* Fieber in Brazil is almost indistinguishable from *N. indica* Linnæus.

The *N. unifasciata* Guérin group, possessing angulate mesotrochanters and a black scutellum margined with flavous, ranges from Mexico northward into British Columbia. The species *N. uni-*

fasciata Guérin embraces several subspecies which in the northern ranges is often abundant in warm or so-called "hot springs." While no records of this species have been made from South America in recent years, there are two specimens in Kirkaldy's collection labeled "S. Amer." and called by him *N. americana*. There are also a few specimens in Vienna labeled "Frfld. Am." and "Frfld. 1874." Where they came from is uncertain.†

The subgenus Bichromonecta Hungerford may have arisen from the Paranecta, but has developed a striking reduction of the penultimate sternite in the female (see text figures, p. 101), a character anticipating the great reduction of this sternite in the next subgenus. The subgenus is typified by *N. shooteri* Uhler and occupies a restricted range from Colombia, South America, on the south to California on the north.

The subgenus Erythronecta Hungerford, of which *N. mexicana* Amyot and Serville is characteristic, occupies the same range as that of Bichromonecta Hungerford.

The subgenus Notonecta Linnæus: This subgenus represented by *N. glauca* Linnæus is characterized by having a digitate process on the male genital capsule. In most of the species the females have long ovipositors for inserting the eggs in the tissues of plants, a character not known in any of the other subgenera. It probably developed from the Paranecta through species much like *N. insulata* Kirby. The most primitive species are *N. maculata* Fabr. and *N. pallidula* Poisson etc., which have short ovipositors and merely attach their eggs to supports in the water, as do all the Paranecta known. Moreover the last abdominal sternite of the female is no more developed than in some species of Paranecta. This subgenus is dominant in Europe and North Africa, a territory, it will be remembered, in which Paranecta is absent. From southern Europe it spreads eastward to India, and from northern Europe we find a circumpolar group typified by *N. lutea* Müller in northern Europe, a species which follows the mountains southward to France, and by *N. borealis* Bueno and Hussey, a boreal species of North America.‡ The subgenus is represented also by a species in Burma, one in China, one in southwestern Siberia, and by *N. irrorata* Uhler in eastern North America. Thus there are 2 species in North America, 1 of them confined to the Boreal; 3 confined to Eastern Asia, 1 to

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† It was supposed that these had been collected by Frauenfeld when Entomologist on the Novara which touched South America at Rio Janeiro, Brazil, and Valparaiso, Chile. This cannot be true, however, since the Novara made its trip around the world in 1857-1859.

‡ We must bear in mind also *N. nigra* Fieber described from Brazil, S. A. See discussion under this species.

Arabia, and 9 species and their subspecies which are found in Europe, the Islands adjacent thereto, and in North Africa. *N. maculata* Fabr. ranges east to India and *N. viridis kashmiriana* Hungerford represents the eastward distribution of this species.

Summarizing the distribution of the genus Notonecta Linnæus we find it well represented in the Western Hemisphere, in Europe, North Africa and Asia.§ It appears to be lacking entirely in the East Indian Archipelago, etc., where it is replaced by the genus Enithares. The genus is divided into five subgenera: PARANECTA, abundant in the Western Hemisphere, is represented in the Eastern Hemisphere by a few species in the Eastern Palæarctic and one in the Ethiopian. BICHROMONECTA and ERYTHRONECTA are confined to the region between Colombia, S. A., and California and New Mexico, U. S. A. The subgenus NOTONECTA is common in Western Palæarctic, has a few species in Eastern Palæarctic, only two species in Nearctic and possibly one in the Neotropical.* Finally the subgenus ENITHARONECTA, which is represented by a single species in the West Australian realm.

The above gives us a picture of the present distribution of the subgenera of Notonecta. Unfortunately there is little evidence in the fossil remains to help us locate the centers of dispersal, as will be seen in the following chapter. Most of our fossils are from the Tertiary and far too recent and too few to assist us. The one from the Jurassic suggests that the Notonectinæ and the Anisopinæ were already separated. The relation of the various genera and subgenera must be based, therefore, upon the morphology of present-day forms and what we may conjecture from their present distribution.

GEOLOGICAL DISTRIBUTION

Only a few fossil species of the family have been described, and these all appear to belong to the Anisopinæ.

The oldest fossil is described under the name *Notonecta elterleini* Deichmüller,[23] and comes from the lithographic chalk in Bayern (Jurassic). Kirkaldy[47] says it must belong to a new genus and Handlirsch[34] says it cannot belong to Notonecta S. Str.

All the other fossils are from the Tertiary and all but one from the old world. Six species from the upper Oligocene, one from lower Miocene, and one from the Florissant in Colorado (Miocene).

The curiously short and thickened front legs of *Notonecta jubata*

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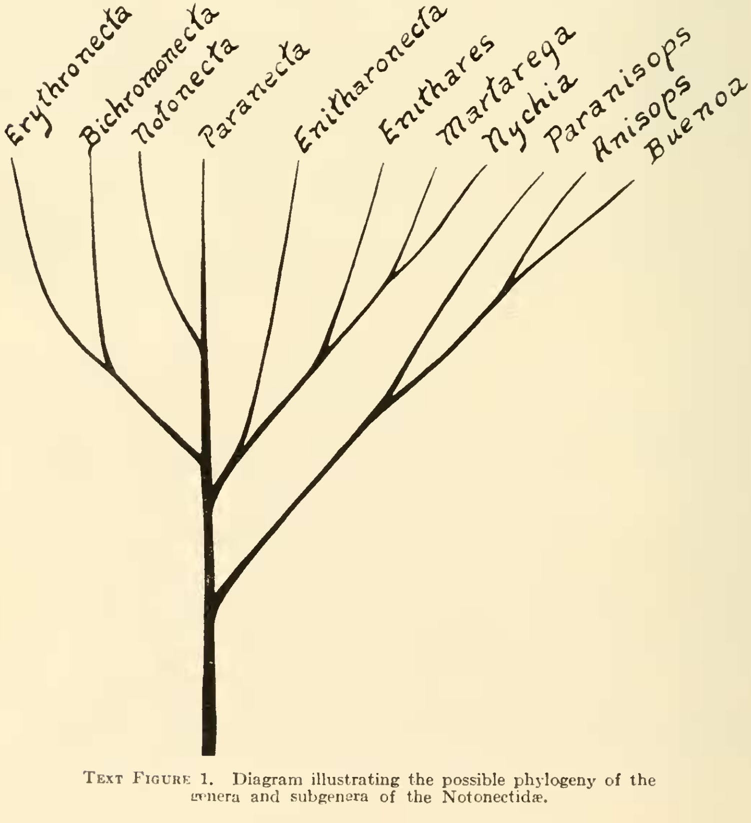
§ Records are lacking over vast stretches of this great continent, due probably to the few collections that have been made.

* *N. nigra* Fieber.

Schlechtendal and apparently also of *N. comata* Schlechtendal and *N. deichmüellari* Schlechtendal make them unlike anything living to-day. While Kirkaldy[47] places *N. hornacki* Schlechtendal as a true Anisops, there is no indication of a stridulatory protuberance on the tibia and the thickened femur suggests that the specimen is a male.

The other European species Kirkaldy either assigns a position near Buenoa or to undescribed genera. To my mind all of them belong in the second category.

Scudder's[76] *N. emersoni* from the Florissant is also impossible to place. If his interpretation that "the median forked line on its posterior portion seems to indicate the hemelytral suture of the upper surface seen through the body" is true, then the insect is a true Anisopinæ, because the claval orifice is present. I supposed from the drawing this was the midventral keel present in all Notonectidæ. The evidence is not clear that any of the fossils belong to existing genera, although the general shape is that of Anisopinæ.



TEXT FIGURE 1. Diagram illustrating the possible phylogeny of the genera and subgenera of the Notonectidæ.

TAXONOMY OF THE NOTONECTA

THE GENUS NOTONECTA LINNÆUS

(Logotype *N. glauca* Linnæus)

1758. Notonecta Linnæus; Systema Naturæ, 10th Edn., p. 439. (For other references see Van Duzee's Catalogue of the Hemiptera, pp. 449-450.)

1801. Notonecta Linnæus; Lamarck, Syst. Nat. Anim. s. Vert., p. 296, names *N. glauca* Linn. as type.

Besides the diagnosis given in the key, the following characteristics may be noted: *

The head shorter than the pronotum. Lateral margin of pronotum compressed dorsoventrally into an edge. Hemelytra clothed more or less with short, flattened hairs. Sides of thorax densely clothed with rather long, flattened hairs. The infracoxal plates covering the bases of the hind coxæ not longitudinally carinate but densely clothed with long hairs.

Male genital capsule with or without a ventral digitiform process. Claspers † or parameres symmetrical.

KEY TO SUBGENERA OF NOTONECTA

A. Last two abdominal sternites of male normal (not long and slender). Male genital capsule not produced caudally on its ventral line, caudal lobes behind claspers not greatly reduced. Claspers not large thin plates.

B. Genital capsule of male without digitiform process. The last abdominal sternite of female not enlarged.

C. Keel of fourth abdominal sternite usually not bare. Eyes normal in size, or if broad not as broad as length of the lateral margin of the pronotum. Penultimate abdominal sternite of female not slender. (See Plate X.)

D. Anterior trochanter of male with or without small hook and with no basal protuberance. Penultimate abdominal sternite of female more or less rectangular........................*Paranecta* (Hutchinson).

DD. Anterior trochanter of male with large, stout hook and a basal protuberance. Penultimate abdominal sternite of female triangular, its tip overlapping base of last segment. (See text figure 7.) *Bichromonecta* (Hungerford).

CC. Keel of fourth abdominal sternite always bare. Eyes unusually broad, about as broad or broader than the short lateral margin of the pronotum. Penultimate abdominal sternite of female slender..*Erythronecta* (Hungerford).

BB. Genital capsule of male with a digitiform process. The last abdominal sternite of female enlarged and usually constricted just before the tip. *Notonecta* (Linnæus).

AA. Last two abdominal sternites of male long and slender. Male genital capsule produced caudally on its ventral line, caudal lobes behind claspers reduced. Claspers large thin plates. Known only from Australia............*Enitharonecta* (Hungerford).

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* Mr. Hutchinson [11] adds statements regarding the venation of the hind wings; they are not correct for the genus. Using his nomenclature *Notonecta lobata* Hungerford has M-Cu strongly "chitinized" and many species show Cu_1 and Cu_2 not only "chitinized" at base, but complete throughout and united distally as in his figure of the wing of *Enithares sobrina* Stal. (Plate XXVII, fig. 5.)

† Snodgrass proposes the name harpagones for these.

Subgenus Paranecta Hutchinson 1929

(Type species *Notonecta lactitans* Kirkaldy)

Hutchinson, G. E., Annals South African Museum, Vol. XXV, Pt. 3, p. 363.

Notonecta in which the male genital capsule lacks a digitiform process and in which the females have the first pair of gonapophyses short and weak. The females have the penultimate abdominal sternite rectagular. The last abdominal sternite of female is not large and is usually incised at tip (see Plate X, fig. 3). The diploid number of chromosomes for those known is 26.

Subgenus Bichromonecta Hungerford 1934

(Type species *Notonecta shooteri* Uhler)

Hungerford, H. B., Jl. Kans. Ento. Soc., Vol. VII, No. 3, p. 98.

Notonecta of compact form with two color phases, one luteous and the other pigmented. The luteous form has reduced flight wing, reduced posterior lobe of membrane, smaller scutellum and less prominent humeri, resulting in more nearly parallel lateral margins of pronotum. The pigmented form has normal wings and more prominent humeri. Eyes are flattened and anterior margins oblique; synthlipsis relatively broad. Anterolateral angles of pronotum embracing the eyes and lateral margins straight to convex. The females have the penultimate abdominal sternite triangular, its tip notched and overlapping the base of the last segment (see text figures, p. 101). The males have a protuberance at the angle and a broad stout hook on the anterior trochanter (see Plate IX, fig. 4). The "internal stay" of the ædeagus is recurved at tip.

Subgenus Erythronecta Hungerford 1934

(Type species *Notonecta lobata* Hungerford)

Hungerford, H. B., Jl. Kans. Ento. Soc., Vol. VII, No. 3, p. 98.

Notonecta of compact form, usually red and black in color. The genital capsule of the male lacks a digitiform process and the "internal stay" of ædeagus is heavily sclerotized. The first pair of gonapophyses of the female is short. The so-called fourth abdominal sternite is broad and short in both sexes and the keel is bare. The penultimate abdominal sternite of the female is very slender and the last one is narrow and usually emarginate at tip (see Plate X, fig. 1).

Subgenus NOTONECTA Hutchinson 1929

(Type species *Notonecta glauca* Linn.)

Hutchinson, G. E., Annals South African Museum, Vol. XXV, p. 363.

Notonecta in which the male genital capsule is provided with a digitiform process and in which the females have the first pair of gonapophyses well developed. The last abdominal sternite of female is large and usually constricted just before the tip, which is not incised. The diploid number of chromosomes for those known is 24 (see Plate X, fig. 4.)

Subgenus ENITHARONECTA Hungerford 1928

(Type species *Notonecta handlirschi* Kirkaldy.)

Hungerford, H. B., Annals Ento. Soc. America XXI, p. 143.

Resembles other Notonecta in general appearance, but decidedly unlike them in shape of last two abdominal sternites of male, which are long and slender, and in the shape of the genital capsule of the male, which is produced cadually on its ventral line. The claspers or parameres are large, thin plates convex without and concave within. The caudal lobes of the capsule are greatly reduced. (See Plate VIII, fig. 4.)

NOTONECTA OF EASTERN HEMISPHERE

KEY TO NOTONECTA OF EASTERN HEMISPHERE

1. Small species, not to exceed 12 mm. long or 4 mm. across humeri*............... (2)
   Species larger than above.. (3)
2. Species plump. Middle femur with distinct spiniferous tubercle near base of rear margin. Last two abdominal sternites of male slender..........*N. handlirschi.* (Australia, p. 27.)
   Species slender, at least three times as long as broad. Middle femur without the distinct tubercle mentioned above. Last two abdominal sternites of male normal ....*N. lactitans.* (S. Africa, p. 28.)
3. Male genitale capsule without digitate prolongation; last abdominal sternite of female not large and constricted near the tip. (See Plate X, fig. 3)............ (4)
   Male genital capsule with digitate prolongation; females of most species with last abdominal sternite large and constricted near the tip. (See Plate X, fig. 4).... (9)
4. Mesotrochanter right angulate..................................*N. kirkaldyi.* (China, p. 30.)
   Mesotrochanter with angle produced.. (5)
5. Typical color, red and black.. (6)
   Typical color flavous and black.. (7)
6. Hair on ventral side of body silvery gray to light brown. Lateral margin of pronotum not sharp-edged. Anterior margin of vertex, seen from above, not flattened ....*N. chinensis.* (China, p. 31.)
   Hair on ventral side of body black. Lateral margin of pronotum sharp-edged. Anterior margin of vertex, seen from above, flattened..............*N. saramoa.* (Formosa, p. 32.)

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* Poisson described his *N. pallidula* as 11.5 mm. to 12 mm. long; all specimens I have seen are at least broader than 4 mm. and most of them longer than 12 mm.

7. Mesotrochanter produced, but not into a long, sharp, thornlike process........... (8)
Mesotrochanter produced into long, sharp, thornlike process. (See Plate IX.)
N. kiangsis.
(China, p. 33.)

8. Connexivum black beneath....................................*N. immediata.*
(E. Siberia, p. 35.)
Connexivum green to flavous....................................*N. triguttata.*
(Japan, p. 36.)

9. Mesotrochanter right angulate. General facies reddish-orange, unevenly marked with black ....*N. montandoni.*
(China, p. 37.)
Mesotrochanter rounded .... (10)

10. Last abdominal sternite of female not constricted near the tip. (See Plate X, fig. 3), (11)
Last abdominal sternite of female constricted near the tip (see Plate X, fig. 4) or large and depressed on sides before the tip.................................. (14)

11. Scutellum pale, sordid brown....................................*N. pallidula.*
(N. Africa, p. 38.)
Scutellum black .... (12)

12. Anteapical tooth of mesofemur of normal size. (See Plate VI, fig. 5.) Metanotum and first abdominal tergite orange or yellow.............................. (13)
Anteapical tooth of mesofemur unusually long. Metanotum black....*N. canariensis.*
(Canary Islands, p. 40.)

13. Anterolateral angles of pronotum slightly produced..................*N. maculata.*
(Western and Southern Europe, North Africa, and eastward to India, p. 41.)
Anterolateral angles of pronotum obtuse......................*N. meinertzhageni.*
(Hoggar Mountains in the Sahara, p. 44.)

14. Last abdominal sternite of female large and slightly depressed on the sides before the tip ....*N. arabiensis.*
(Arabia, p. 44.)
Last abdominal sternite of female strongly depressed on the sides before the tip or strongly constricted before the tip.. (15)

15. Anterior angles of pronotum not acute or closely embracing the eyes. (See Plate VIII, fig. 8).. (16)
Anterior angles of pronotum acute and closely embracing the eyes. (See Plate XVII, fig. 4).. (26)

16. Scutellum typically entirely black.. (17)
Scutellum not entirely black.. (25)

17. Large reddish species, more than 6 mm. across humeri................*N. violacea.*
(Burma, p. 45.)
Species not surpassing 5.4 mm. across humeri.................................. (18)

18. Hemelytra typically yellowish or flavous, lacking oblique stripes.................. (19)
Hemelytra reddish or brownish, maculated or not.............................. (20)

19. Hemelytra typically yellowish or flavous, with brownish or blackish maculations (sometimes confluent) along costal margin, and often a transverse spot at apex of clavus and internal angle of corium......................*N. glauca glauca.*
(Northern Europe and southward to Central France, p. 46.)
Hemelytra yellowish or flavous with a broad transverse black band covering distal third of corium, tip of clavus and basal portion of membrane..*N. glauca poissoni.*
(Asia Minor, p. 49.)

20. Hemelytra reddish or brownish, maculated or not.............................. (21)
Hemelytra largely velvety black with one or two flavous stripes at the base........ (22)

21. Hemelytra more or less strongly maculated, presenting at the base either one pale longitudinal stripe on the clavus, or two such stripes, one on the clavus and the other on the corium....................................*N. glauca hybrida.*
(Southern France to North Africa, p. 50.)
Hemelytra generally clear reddish, sometimes with some vague markings of dull black in the marginal canal and some drop-shaped spots on the disc.
*N. glauca rufescens.** (*N. glauca fulva?*)
(Southern Europe, N. Africa, p. 51.)

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* Doctor Poisson mentions a new subspecies, *N. glauca kirvillei*, from Asia Minor, which he says is related to this.

22. Size usually 15 to 16 mm. . . . . (23)
Size usually 13 to 14 mm. (If larger with only one pale stripe on hemelytron). . . . . (24)
23. Hemelytra with two very clear flavous stripes at the base, the one on corium a little shorter than the one on the clavus. . . . .*N. obliqua obliqua.*
(Northern Europe to Central France, p. 51.)
Hemelytra as above, plus one large flavous spot beyond distal end of the stripe on corium . . . .*N. obliqua delcourti.**
(Belgium and Northwestern France, p. 54.)
24. Hemelytra with two flavous stripes, but the one on corium more or less restricted or only the claval stripe present, and perhaps some yellowish spots in place of the corial stripe . . . .*N. obliqua meridionalis.*
(About the Mediterranean, p. 54.)
25. Size very large: 17 mm. to 18.3 mm. long. Last abdominal sternite of female greatly and abruptly constricted before the tip. . . . .*N. amplifica.*
(E. Siberia, p. 55.)
Size seldom over 15 mm. long. Last abdominal sternite of female only moderately and not abruptly constricted before the tip. . . . .*N. lutea.*
(N. Europe, p. 56.)
26. Scutellum seldom entirely black, sometimes entirely pale. Anterior trochanter of male with a hook. . . . . (27)
Scutellum solid black. Anterior trochanter of male with slight elevation. . . . . (28)
27. Synthlipsis usually not over half the width of the eye. Last abdominal sternite of female only moderately and not abruptly constricted before the tip. Male clasper as on Plate XVII, fig. 2. . . . .*N. lutea.*
(N. Europe, p. 56.)
Synthlipsis over half the width of the eye. Last abdominal sternite of female abruptly constricted before the tip. Male clasper as on Plate XVII, fig. 1. .*N. reuteri.*
(N. Europe, p. 59.)
28. Hemelytra flavous or greenish flavous, costal margin often maculated and a dark X-shaped figure at tip of hemelytral commissure. . . . .*N. viridis viridis.*
(Western Europe from France southward, north Africa, p. 60.)
Hemelytra largely maculated. . . . . (29)
29. Anterior margin of head as seen from above slightly convex. Genital claspers of male like above. . . . .*N. viridis mediterranea.*
(Mediterranean region and eastward, p. 63.)
Anterior margin of head as seen from above flattened. Genital claspers of male as shown on Plate XVII, fig. 5. . . . .*N. viridis kashmiriana.*
(Kashmir, p. 65.)

Notonecta handlirschi Kirkaldy 1897

(Color Plate IV, fig. 2, Plates VIII, fig. 4, and IX, fig. 7.)

1897. *N. handlirschi* Kirkaldy, Trans. Ento. Soc. London, p. 408.
1904. *N. handlirschi* Kirkaldy, Wien. Ento. Zeit. xxiii, p. 132.
1923. *N. handlirschi* Kirkaldy; Hale, Rec. S. Aust. Mus., Vol. II, No. 3, June 30, p. 418.
1928. *N. handlirschi* Kirkaldy; Hungerford, Annals Ento. Soc. Amer. xxi, p. 143, Pl. ix, fig. 6. (Fig. genital capsule.) (New subgenus Enitharonecta.)
1929. *N. handlirschi* Kirkaldy; Hutchinson, Annals of the South African Museum, Vol. xxv, Part 3, p. 363.

Size. Length 10 mm. to 10.5 mm.; width of pronotum 3.5 mm. to 4 mm.

Color. As shown on Color Plate IV, fig. 2. A species with reddish hemelytra sometimes nearly black, with clavus dark reddish brown. Metanotum and dorsum of abdomen rufotestaceous. Venter black.

Structural Characteristics. Anterior outline of head viewed from above flattened; vertex slightly shorter than its anterior width; margin of vertex less convex than the margin of the eye; anterior breadth of vertex:synthlipsis::22:13.* Pronotum twice the length of the head; lateral margins straight and moderately divergent; anterolateral angles produced forward beyond the caudolateral margins of the eyes; lateral ledge as seen from the side slightly curved, oblique and about as long as rear margin of the eye below it. Scutellum longer than the pronotum. Hemelytral commissure shorter than pronotum; posterior lobe of membrane well developed. Anterior trochanter of the male without hook or elevation. Mesotrochanter rounded or faintly angulate; mesofemur with distinct spiniferous tubercle on base of caudal margin; the distal mesofemoral tooth not prominent. The last two abdominal sternites long and slender in the male; the lobe of ninth tergite slender and pointed. The male genital capsule as shown on Plate VIII, fig. 4. The claspers are thin plates, convex without and concave within; as one views the clasper from the rear there is a recurved, short submarginal fold parallel with the upper margin; a much lesser thickening occurs before the tip below the upper margin; neither of these is visible from the lateral view.

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* A variety, not a subspecies.

Location of Type. Two males in the Vienna Museum. They bear the label "Fischer, Austr. Post 1, 1878." One of them now (1928) has the abdomen damaged by dermestids.

Comparative Notes. This species, the only one in the genus reported for Australia, appears to stand quite alone. For this reason I have placed it in a subgenus by itself.

Data on Distribution. There is a male specimen in the British Museum labeled "Western Australia, 1922-1923, B. R. Lucas." In this specimen the scutellum is black and the hemelytra nearly black, with the clavus dark reddish brown.

Notonecta lactitans Kirkaldy 1897

(Color Plates IV, fig. 3 and V, fig. 12; Plates VIII, fig. 9 and IX, fig. 8.)

1897. *N. lactitans* Kirkaldy, Ann. Mag. Nat. Hist., (6) xx, p. 58.

1897. *N. lactitans* Kirkaldy, Trans. Ento. Soc. London, p. 405.

1904. *N. lactitans* Kirkaldy, Wien. Ento. Zeit., xxiii, p. 132.

1925. *N. lactitans* Kirkaldy; Hungerford, Annals Ento. Soc. Am., xviii, p. 417.

1929. *N. lactitans* Kirk.; Hutchinson, Annals of South African Museum, xxv, Pt. 3, pp.363 and 365-368. (Type of Paranecta subg. n.) Pl. xxvii, figs. 1, 2 and 3 (Head and pronotum, mesofemur and hind wing); Pl. xxviii, figs. 1, 2 and 3 (Genital capsule, aedeagus and clasper); Pl. xxix, figs. 10 and 11 (Head and pronotum of ? 3rd and 5th instars).

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* Kirkaldy says: "Vertex not quite as wide as synthlipsis." This is not true in the types which I have examined on two occasions.

Referring to this species, also:

1897. *N. lactitans* var. *stygica* Kirkaldy, Trans. Ento. Soc. London, p. 406. This is the male of *N. lactitans* Kirk.

1904. *N. lactitans* var. *stygica* Kirkaldy, Wien. Ento. Zeit., xxiii, p. 132. (Name listed only.)

Size. Length 10.5 mm. to 12 mm. The females longer than the males. A slender species that is at least three times as long as broad.

Color. A yellowish gray and black species as shown on Color Plates IV and V. The males are darker than the females. Scutellum is black. Scutellum and hemelytra covered sparcely with short, fine, golden pubescence. Abdominal dorsum and venter dark.

Structural Characteristics. Head small, notocephalon very faintly longitudinally carinate on posterior half. Vertex broad at base. Anterior breadth of vertex : synthlipsis :: 5.6:3.5. Pronotum twice as long as the head, anterior angles obtuse, lateral margins slightly divergent and sinuate; lateral marginal ledge nearly straight terminating caudally below the humeral elevation. Scutellum slightly longer than the pronotum. Outer lobe of membrane very slightly longer than inner. Anterior trochanters of male without hook. Mesotrochanters slender, rounded, a small tuft of long hairs at the base. Mesofemur with tuft of bristle-like hairs on basal angle of rear margin. The subapical tooth directed slightly toward apex. Small tuft of hairs on median line of the short third ventral abdominal segment, fourth ventral abdominal segment longest, terminal one in female deeply notched. Male genital capsule as shown in Plate VIII, fig. 9. First pair of gonapophyses of female short.

Location of Types. Kirkaldy recorded the type as being in his own collection and listed: "Africa, Guinea (my coll.); Gaboon (Vienna Mus.); Cape of Good Hope (Paris Mus.)". The type, a female, broken and dismembered is in the U. S. N. M. with the Kirkaldy collection. In the Vienna Museum there is a female labeled cotype and "Gaboon Coll. Signoret." Thorax on the left side has been eaten by dermestids (1928). In the Paris Museum there is also a female bearing a red label "Comp. with type by Kirkaldy in Kirkaldy Coll." This is the specimen mentioned by Kirkaldy as from Cape of Good Hope. It carries the label "Museum Paris. Cap de Bonne Esperance. Delalande 1820." The type of *N. lactitans* var. *stygica* Kirk. is in the British Museum. It is only the dark male of *N. lactitans* Kirkaldy.

Comparative Notes. The most slender Notonecta known and the only representative of the Genus in Africa south of the Sahara.

The males are usually darker than the females, the hemelytra being blackish with the outer margin of the embolium, a streak on outer edge of clavus and a spot on the inner part of the posterior margin of the corium dull yellow. As Mr. Hutchinson has pointed out, this species is quite distinct, but more nearly related to the Western Hemisphere forms than to the European. It is the type of Hutchinson's subgenus Paranecta.

Data on Distribution. Besides the type localities listed by Kirkaldy, Mr. Hutchinson has recorded some thirteen collections in the Cape and believes that: "In the Cape Peninsula there is a migration from mountain pools in the autumn to low-lying waters on the Cape Flats and elsewhere in which the insects breed, the newly emerged adults then ascending and populating the localities left by their parents." I have specimens kindly sent to me by F. W. Pettey from Elsenbourg, S. Africa, and from Muilder's Vlei, Cap. Prov. There are four specimens in Dr. Herbert Osborn's collection "Vlei Su Pr. Common June 6, 1909."

Character of Habitat. The specimens sent to me by Mr. Pettey are from a clear mountain stream pool. Hutchinson records collections from reservoir, bog, pond, weedy pool and pools in streams. The elevations range from low flats to a pool near the top of a pass in the mountains. The highest elevation he gives is 4,200 feet.

Life History Notes. Hutchinson says the eggs are unknown, but presumably are laid on submerged objects without being imbedded. He describes what he believes to be the third, fourth and fifth instars.

Notonecta kirkaldyi Martin 1902

(Color Plate V, fig. 9; Plate XV, fig. 3.)

1902. *N. kirkaldyi* Martin; Bull. Mus. d'Hist. Nat. (Paris), viii, p. 336.
1904. *N. kirkaldyi* Martin; Kirkaldy, Wien. Ento. Zeit., xxiii, pp. 95 and 132.
1925. *N. kirkaldyi* Martin; Esaki, Notula Entomologicæ, v. p. 14.
1925. *N. kirkaldyi* Martin; Hungerford, Annals. Ento. Soc. Am., xviii, p. 418.

Size. Length, 13 mm.; width across thorax, 4.6 mm.

Color. A reddish orange and black species. Head and limbs of usual testaceous color. Scutellum black. Hemelytra reddish orange and black; the distal end of clavus, a stripe on corium bordering clavus and a broad irregular band of black crossing distal half of corium; the membrane is dark brown to black.

Structural characteristics. Anterior breadth of vertex : synthlipsis :: 7:3; head appearing fairly long; its length to that of pronotum :: 2.5:4.2. Lateral margins of pronotum diverging and nearly straight; anterior angles normal; lateral ledge, seen from the side, straight with rear end turned upward beneath the humeral elevation. The scutellum a little longer than pronotum (nearly 5 to 4). Posterior lobe of membrane slightly longer than anterior. Anterior trochanter of the male without hook or tooth. Mesotrochanter right angulate. Mesotibia with slight prominence on rear margin. Female not examined by me. Male genital capsule as shown on Plate XV, fig. 3.

Location of Type. Paris Museum, cotypes in U. S. N. M. and in my collection.

Comparative Notes. A smaller species than *N. chinensis* Fallou and with the trochanter of middle leg right angulate instead of acutely angulate.

Data on Distribution. Described from "Yun-Nan-Nansen (Mgr. Excoffier) R. Oberthur. 1898." There were 31 specimens in the type series in the Paris Museum, all labeled as above.

Notonecta chinensis Fallou 1887

(Color Plate V, fig. 8; Plate XV, fig. 8.)

1887. *N. chinensis* Fallou; Le Naturaliste (Deyrolle Paris), viii, p. 413.

1894. *N. chinensis* Fallou; Bergroth, Rev. Ento. franc., xiii, p. 164. Redescribed at length.)

1897. *N. chinensis* Fallou; Kirkaldy, Trans. Ento. Soc. London, 1897, pp. 415, 416.

1904. *N. chinensis* Fallou; Kirkaldy, Wien. Ento. Zeit., xxiii, pp. 95 and 132.

1912. *N. chinensis* Fallou; Oshanin, Katalog der paläarktischen Hemipteren, p. 91.

1925. *N. chinensis* Fallou; Esaki, Entomolog. Mitteilungen, xiv, 1925, Nr. 5/6, p. 312.

1925. *N. chinensis* Fallou; Hungerford, Annals Ento. Soc. Am., xviii, p. 418.

1930. *N. chinensis* Fallou; Hungerford, Bull. Brook. Ento. Soc., xxv., No. 3, p. 138.

1930. *N. chinensis* Fallou; Kiritshenko, Annuaire du Musée Zoölogique de l'Académie des Sciences de l'U. R. S. S., p. 434.

Referring to this species, also:

1873. *N. sinica* Walker, Cat. Hem.-Het. Brit. Mus., viii, p. 204. (Kirkaldy.)

Size. Length, 13-14 mm.; width across thorax, 4.5 mm. to 5.1 mm., the females averaging a little larger than the males.

Color. An orange-red and black species. Head, pronotum and limbs light testaceous. Face, limbs and connexivum beneath may be greenish. Scutellum black. Hemelytra orange-red to red-brown with an undulating bluish-black band (occasionally represented by scattered spots) extending from suture to lateral margin, near the apical margin of the corium, but diverging from that as it approaches the lateral margin; membrane bluish-black.

Structural Characteristics. Eyes close together at synthlipsis; anterior breadth of vertex : synthlipsis : : 26 : 7; head about fiveeights as long as pronotum. Lateral margins of pronotum divergent and sinuate; anterior angles somewhat produced; lateral ledge as seen from the side slightly sigmoid. Scutellum a little longer than pronotum. Lobes of membrane about equal in length. Anterior trochanter of male with a median raised dentation in place of hook; mesotrochanter acutely angulate, the angle produced. Terminal abdominal sternite of female with lateral margins concave and apex shallowly notched. Female gonapophyses of moderate length. Male genital capsule as shown on Plate XV, fig. 8.

Location of Type. Fallou collection in Paris Museum. The male type is from Fo-Kien.

Comparative Notes. This species is readily separated from other oriental Notonecta (except *N. kiangsis* Kirk. and *N. saramoa* Esaki) by the very narrow interocular space (synthlipsis). *N. kiangsis* Kirk is very different in color, more slender in form, and the angle of the mesotrochanter is produced into a long, sharp thorn-like process.

Data on Distribution. Kirkaldy says, "Well distributed over the Chinese Empire" and gives the following: "Pekin, Kian-Si, Se-Tchouen, Chen-Si (Paris Mus.) Kin Kiang (? Chin-Kiang), Foo-Chan (Brit. Mus.) Fo.-Kien (Fallou and Bergroth Co.), Ngan Hoei, (Montandon and my colls.)."

The following additions I have noted: "Prov. Fo Kien (China) G. Siemssen vend. 31-v-1904 (Hamburg Mus.)"; "Chin Kiang, China V, 20, 1924, E. Suenson" (my coll.); Peking, China, Oct., 1925, P. W. Claassen, (my coll. and Cornell); Hweisin, Kansu, China (my coll.).

Notonecta saramoa Esaki 1933

(Plate XV, figure 7)

1933. *N. saramoa* Esaki; Trans. Nat. Hist. Soc. Formosa, Vol. XXII, pp. 493-495.

Size. Length, 13.5 mm. to 14 mm.; width across thorax, 4.5 mm. to 5 mm.

Color. An orange-red and black species resembling very closely *N. chinensis* Fallou. The broad, black band commonly present across the end of the clavus and corium in *N. chinensis* Fallou is replaced by three angular spots in the four paratypes before me. However, the species from China sometimes has identically these markings. Hair on ventral side of body black.

Structural Characteristics. Eyes close together at synthlipsis; anterior margin of vertex, seen from above flattened; anterior breadth of vertex : synthlipsis : : 29:9. Head about half as long as pronotum;

lateral margins of pronotum divergent, slightly sinuate in the male, more so in the female; anterior angles somewhat produced; lateral ledge as seen from the side thin and sigmoid. Scutellum a little longer than pronotum. Lobes of membrane about equal in length. Anterior trochanter of male with a median raised dentation in place of a hook; mesotrochanter acutely angulate, the angle produced. Terminal abdominal sternite of female with lateral margins concave and apex faintly incised. Male genital capsule as shown on Plate XV, fig. 7.

Location of Type. In collection of Professor Teiso Esaki. Four paratypes in the Francis Huntington Snow Entomological Museum. These paratypes are labeled: "Formosa," "Meoto-ike (Taichu-shu) near Kunugigaoka, 8,000 ft., 17 - VII, 1932, Teiso Esaki." and were collected in a small pond with the holotype in central Formosa. Other paratypes were collected in Mururoafu-no-ike, a larger pond 7,500 ft. in Taiheizan district, Northern Formosa, on July 23, 1932, by Professor Esaki. Paratypes will also be found in the collections of the Government Research Institute of Formosa, Taihoku and in the British Museum.

Comparative Notes. This species is near *N. chinensis* Fallou, from which it is distinguished by its more truncate head, by the thin lateral edge of pronotum, by the black hair on the ventral side of the body, by shape of genital capsule and mesotrochanter.

Data on Distribution. Known only by the type series from Formosa.

Notonecta kiangsis Kirkaldy 1897

(Color Plate V, fig. 7; Plate XV, fig. 5.)

1897. *N. chinensis* Fallou var. *kiangsis* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 416.

1904. *N. chinensis* Fallou var *kiangsis* Kirkaldy, Wien. Ento. Zeit., xxiii, p. 132 (lists name only).

1925. *N. kiangsis* Kirkaldy; Esaki, Notul. Entom., Helsingfors v, p. 15.

1929. *N. kiangsis* Kirkaldy; Hutchinson, Annals S. African Museum, xxv, pt. 3, p. 363.

1930. *N. kiangsis* Kirkaldy; Hungerford, Bull. Brooklyn Ento. Soc., xxv, p. 138.

1930. *N. kiangsis* Kirkaldy; Kiritchenko, Annuaire du Músee Zoöl. de l'Académie des Sciences de l'URSS., pp. 436 and 440.

Referring to this species, also:

1925. *N. bergrothi* Esaki, Notul. Entom. Helsingfors v, p. 14.

1925. *N. bergrothi* Esaki, Entom. Mitt., Berlin-Dahlem, xiv, p. 313 (fig. 1).

1925. *N. suensoni* Hungerford, Annals Ento. Soc. America, xviii, p. 417.

1926. *N. suensoni* Hungerford, Annals Ento. Soc. America, xix, p. 92. (Syn. note = *N. bergrothi* Esaki).

Size. Length of male, 12.5 mm.; of female, 13.8 mm.; width across the eyes, male, 2.28 mm.; female, 3 mm.; width across widest part of pronotum, male, 4 mm., female, 4.5 mm.

Color. General color luteous. Scutellum black. Sparse silvery pubescence on hemelytra. Brownish-black band along apical margin of clavus (caudal half of elytral commissure); slender, brown line on base of clavocorial suture, and another longitudinal line on disk of corium; margins and distal third of embolium more or less brownish; distal portion of corium marked with two nearly quadrate brownish-black areas, one before the other, the posterior one larger and both covered with conspicuous silvery hairs; inner angle of corium and inner base of membrane embrowned. Venter black. The ventral side of the connexivum greenish.

Structural Characteristics. Head long; eyes close together at synthlipsis; vertex : synthlipsis :: 5:1. Lateral margins of pronotum divergent, sinuate, and narrowly explanate; anterior angles acute; lateral ledge, as seen from the side, faintly sigmoid and ending caudally just beneath the humeral elevations, which are not marked. Scutellum slightly longer than pronotum. Anterior lobe of hemelytral membrane slightly longer than posterior lobe. Anterior trochanter of male with a small tubercle, two-fifths of distance from base to apex. The angle of the mesotrochanter produced into a long, slender, pointed process. Small hair tuft on median line of third ventral abdominal segment, fourth ventral abdominal segment longest. Last ventral segment of female but shallowly notched. First pair of gonapophyses of female short. Male genital capsule as shown on Plate XV, fig. 5.

Location of Types. In Paris Museum. At the end of his discussion of *N. chinensis* Fallou, Kirkaldy says: "To this species I have referred four specimens in the Paris Museum (from Chen-Si, Se-Tchouen, and Kiang-Si) which seem sufficiently distinct to bear a varietal name—*kiangsis* var. nov." This was followed by a short description of color. Since Kirkaldy gave it as a variety name, and gave only a color description, it was assumed by both Professor Esaki and me that his variety was structurally identical with *N. chinensis* Fallou. We, therefore, independently, but the same year, 1925, described as new, specimens that came to our hands. Sometime later Esaki found three specimens in the Paris Museum labeled by Kirkaldy "*Notonecta chinensis* Fallou var. 1897" that bear the locality labels mentioned above. While not bearing the name *kiangsis* nor marked types, they certainly are to be so considered. In 1928 I also examined these specimens. How anyone of Dr. Kirkaldy's experience could have thought them to be a variety of *N. chinensis* Fallou is a puzzle to me.

Comparative Notes. This species is very distinct from any others of the orient. It differs from all of them by its pale color and more slender shape. It differs from *N. montandoni* Kirkaldy, *N. violacea* Kirkaldy, *N. Kirkaldyi* Martin and the *N. glauca* group in having the angle of the mesotrochanter plainly produced. In this respect it is like *N. triguttata* Motsch. and *N. chinensis* Fallou, from which it is readily separated by this process being longer and sharper. The claspers of the male are also different.

Data on Distribution. Esaki described his specimens from Amur and Ussuri and says in his 1927 paper: "This species is now known to be widely distributed in Central and Northeastern China and East Siberia." There are also many specimens from South Ussuri in the Zoölogical Museum of the Academy of Sciences, St. Petersburg (Leningrad) and a single specimen from "China meridionalis in the Hungarian National Museum, Budapest." My specimens are as follows: "Shanghai, China, April 22, 1923; E. Suenson. (Holotype and allotype of *N. suensoni* Hungerford"; "Tsing Hua Col. Peking, China, 11-8-1924, P. W. Claassen"; another collection in 1925 at same place by Doctor Claassen; Mr. Suenson also sent me some collected April 18, 1926, from Shanghai; Hweisin, Kansu, China (my coll.); Dr. Kiritshenko gives southeastern Siberia, Manchuria, Korea, North China and the oriental region.

Character of Habitat. I have no data on this point.

Notonecta immediata Kiritshenko 1930

(Color plate V, fig. 6.)

1930. *N. immediata* Kiritshenko, Anniaire du Musée Zoölogique de l'Académie des Sciences de l'U. R. S. S., p. 438. (Figs. 5, 6, 9 and 10.)

Thanks to the kindness of Doctor Kiritshenko, I possess a female paratype of this species. Aside from the difference mentioned in the key, I cannot distinguish it from *N. triguttata* Motsch. from Japan. It may be that the male shows some specific structural difference. The punctations on the partype in my possession do not clearly separate it from *N. triguttata.* I quote below Doctor Kiritshenko's description and notes:

"♂, ♀. Corpus elongatum, sat angustum, superne et inferne fere totum nigrum. Caput, fronte, viridi excepta, et pronotum superficie superna tota nec non inferne limbis lateralibus sat latis albida. Hemelytra nigra, clavo dimidio basali toto, plaga communi clavi et corii, comissuram clavi occupante et apicem clavi haud attingente, corii plaga propter venam radialem nec non macula parva ad medium suturæ membranæ sita lutescentibus; exocorio margine externo etiam tenuiter lutescenti-limbato, clavo ad dimidium apicalem marginis scutellaris vitta angusta submarginali arcuata lutescenti, propter comissuram clavi breviter prolongata prædito; membrana et ventre toto nigris. pedibus sordide flavescenti-virescentibus.

"Caput ante oculos late rotundatum, vertice synthlipsi triplo latiore. Pronotum latitudini suæ anticæ aequilongum, latitudine postica duplo brevius, marginibus lateralibus a supero visis subrectis, angulis anticis rectangularibus, superficie superna nitida, tenuiter punctulata; metanotum totum nigrum. Scutellum totum nigrum, opacum, densissime punctatum, apice acuminatum et longe attenuatum, latitudine sua basali paullo brevius. Hemelytra densissime punctata, pilis incumbentibus aureis parce tecta, angulo apicali corii multo densius piloso, comissura clavi margine scutellari aequilonga, lobis membranæ aequalibus et aequilongis. Abdomen supra nigrum, segmentis 4 ultimis margine externo flavescenti-maculatis.

"Long. corporis 13.5-14 mm., long pronoti 2.6-2.8 mm., lat. hemelytrorum 4.4-5.1 mm., lat. synthlipsis 0.7-0.8 mm.

"Habitat in prov. Primorskaja Sibiriæ orientalis: Novokievskoje in litore sinus Posjet (27-28 IX 1928, Prinada leg., Posjet (11 V 1928, Volk leg.).

"Species supra descripta ad sectionem specierum generis orientali-asiaticarum: *N. triguttata* Motsch., *N. chinensis* Fallou, *N. kirkaldyi* Martin, *N. kiangsis* Kirk. pertinet, ex quibus *N. triguttata* Motsch., specie japonica valde affinis et similis, differt statura angustiore et longiore, connexivo, ventre et maxima parte hemelytrorum nigris, hemelytris praecipue clavo et exocorio distinctius punctatis; a *N. kiangsis* Kirk., specie alia ussuriensi, magnitudine majore et latiore, colore, vertice latiore facile cognoscitur."

Notonecta triguttata Motsch. 1861

(Color Plate IV, fig. 4; Plate XV, fig. 6.)

1861. *N. triguttata* Motschulsky, Etudes Ento., x, p. 24.

1897. *N. triguttata* Motsch.; Kirkaldy, Trans. Ento. Soc. London, p. 417.

1904. *N. triguttata* Motsch.; Kirkaldy, Wien. Ento. Zeit., xxiii, p. 95, 132.

1912. *N. triguttata* Motsch.; Oshanin, Katalog der paläarktischen Hemipteren, p. 91.

1925. *N. triguttata* Motsch.: Esaki, Notulæ Entomologicæ, v, p. 14, fig. 2. (Figures. head and pronotum.)

1925. *N. triguttata* Motsch.; Hungerford, Annals Ento. Soc. Am., xviii, p. 418. (Notes.)

1928. *N. triguttata* Motsch.; Hutchinson, Ento. Mo. Mag., lxiv, pp. 36, 37. (Figures male genital capsule.)

1929. *N. triguttata* Motsch.; Hutchinson, Annals South African Museum xxv, Pt. 3, p. 363. (Subg. Paranecta.)

1930. *N. triguttata* Motsch.; Kiritshenko, Annuaire du Musée U. R. S. S. Zoölogique de l'Academic des Sciences de l'U. R. S. S., p. 436.

Size. Length, 13-14 mm.; width across thorax, 4.5 mm. to 5.1 mm. The females appear to be larger than the males.

Color. Black and flavous. Head and limbs of usual color; scutellum black; hemelytra black or bluish black with two oblique flavous stripes on basal half and spot on distal margin of corium midway between lateral margins; sometimes the flavous bands are broad and coalesce, again they may be reduced to narrow lines. The general pattern is that of *N. obliqua* Gallén. The venter and the dorsum of abdomen are dark in color.

Structural Characteristics. Head relatively smaller than in *N. chinensis* Fallou; anterior breadth of vertex : synthlipsis :: 13:5; head a little more than half as long as pronotum. Lateral margins of pronotum divergent and but slightly sinuate or incurved, nearly straight, especially in the males; anterior angles of pronotum normal; lateral ledge as seen from the side, faintly sigmoid, the rear end turned up beneath the humeral elevations. Scutellum longer than pronotum. Posterior lobe of membrane a trifle longer than anterior lobe. Anterior trochanter of male with a small dentation instead of a hook; mesotrochanter with angle sharply produced. Terminal abdominal sternite in female notched at tip; female with first pair of gonapophyses short; male gential capsule as shown on Pl. XV, fig. 6.

Location of Type. Kirkaldy wrote "?Moscow." In 1915 Kiritshenko examined Motschulsky's types and reported that there were two specimens, one labeled "Japonia" and one without locality label. They are at Moscow.

Data on Distribution. Japan. Kirkaldy, in his "Uber Notonectiden," adds, "Shantung, China—Distant collection."

Notonecta montandoni Kirkaldy 1897

(Color Plate IV, fig. I; Plate XVII, fig. 6)

1897. *N. montandoni* Kirkaldy, Ann. and Mag. Nat. Hist. (6), xx, p. 56.

1897. *N. montandoni* Kirkaldy, Trans. Ento. Soc. London, 1897, pp. 417, 418.

1904. *N. montandoni* Kirkaldy, Wien. Ento., xxiii, pp. 95 and 132.

1906. *N. montandoni* Kirkaldy; Distant, Faun. Brit. Ind. Rhynchota, vol. iii, p. 41, fig. 25.

1912. *N. montandoni* Kirkaldy; Oshanin, Katalog der paläarktischen Hemipteren, p. 91.

1925. *N. montandoni* Kirkaldy; Hungerford, Annals Ento. Soc. Am., xviii, p. 418 (notes).

1925. *N. montandoni* Kirkaldy; Esaki, Notulæ Entomologiæ, v, p. 13.

1930. *N. montandoni* Kirkaldy; Kiritshenko, Annuaire du Musée Zoölogique de l'Académie des Sciences de l'U. R. S. S., p. 436.

Referring to this species, also:

1905. *N. bivittata* Matsumura, Jl. Sapporo Agric. Coll., vol. ii, p. 59, Pl. 1, fig. 9 ♀, 1905 (Esaki).

1925. *N. bivittata* Matsumura; Esaki, Notulæ Entomoligicæ, p. 14, footnote says examined the type and finds it to be *N. montandoni* Kirkaldy.

Size. Length, 15 mm. to 16 mm.; width across prothorax, 5 mm. to 5.5 mm.

Color. Head and limbs of usual color; scutellum black; hemelytra reddish-orange unevenly marked with black, the black figures often coalescing into an irregular transverse band across corium, membrane black with basal part of anterior lobe somewhat mottled with the ground color of the corium.

Structural Characteristics. Head with the anterior breadth of vertex : synthlipsis : : 15:6. Some specimens have synthlipsis a little narrower than above. Head half as long as pronotum. Lateral margins of pronotum divergent and nearly straight, but slightly convex on anterior half; anterior angles normal; lateral ledge, seen from the side, slightly oblique and up-curved beneath the humeral prominence. Scutellum slightly longer than pronotum (6:5). Lobes of hemelytral membrane about equal in length. Anterior trochanter of male without hook or tooth. Mesotrochanter nearly right angulate. Mesofemur with anteapical tooth of usual form. Terminal abdominal sternite of female somewhat constricted near apex, which is not notched. Female gonapophyses of moderate length. Male genital capsule as shown on Plate XVII, fig. 6.

Location of Type. "Montandon collections."

Comparative Notes. This species is a little larger than *N. chinensis* Fallou and has some maculations on basal half of hemelytra. It also has a mesotrochanter that is right angulate instead of acutely angulate as in *N. chinensis* Fallou, *N. triguttata* Motsch., *N. kiangsis* Kirkaldy, and *N. immediata* Kiritch.

Data on Distribution. Given in Kirkaldy's Revision of the Notonectidæ as follows: "China Kiang-Si (Paris Mus.), Ngan-Hoei (Montandon and my collns.), Mou Piu, Tibet. (Paris Mus.)" Paris Museum also has specimens labeled "Museum Paris Kouy-Tchéou, Kouy-Yang, P. P. Cavalerie et Fortunat 1906." The U. S. N. M. has some labeled: "Shin Kai Si, Mt. Omei, Szechuen, China, 4,000-6,000 ft., D. C. Graham, collector"; "Suifu, Szechuen, China, 1920. D. C. Graham Coll."; "4,400 ft. Shin Kai Si Mt. Omei, near Kianting, Szechuen, China, D. C. Graham;" Kiritshenko lists Japan, China and oriental region.

Notonecta pallidula Poisson 1926

(Color Plate V, fig. 2; Plate XVII, fig. 3)

1926. *N pallidula* Poisson, Bull. Soc. Hist. Nat. Afr. Nord, xvii, p. 238, figs. 1 and 2. (Figs. of head and pronotum and genital capsule.)

1928. *N. pallidula* Hutchinson, Ento. Mont. Mag., lxiv, p. 35.

1928. *N. pallidula* Poisson, Bull. Soc. Ento. France, No. 6, pp. 105, 106.

1929. *N. pallidula* Poisson; Hutchinson, Annals of South African Museum, xxv, pt. 3, p. 363.

1933. *N. pallidula* Poisson, Annals de la Soc. Ento. de France, Janvier, 1933.

1933. *N. pallidula* Poisson, Bull. de la Soc. Scien. de Bretagne X, Fasc. III et IV. (Reprint p. 1.)

Referring to this species, also:

1897. *N. glauca* var. *maculata* "leucochroic form" Kirkaldy, Trans. Ento. Soc. London, 1897, pp. 422, 423.

1927. *N. horvathi* Esaki, Ann. & Mag. Nat. Hist. (9), xx, p. 284, figs. 1, 2, 4. (Figs. dorsal view of insect, lateral view of head and thorax and tips of hemelytral membranes.)

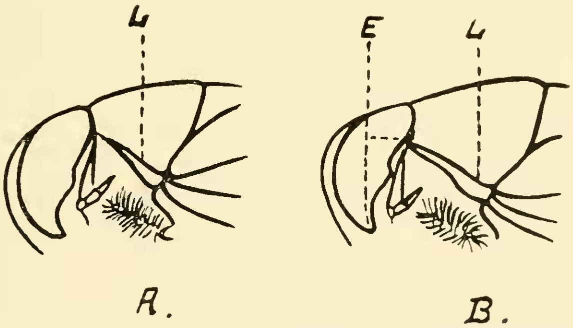
Size. Length, 11.5 mm. to 13 mm.; breadth of pronotum, 4 mm. to 4.5 mm. Females slightly larger than the males.

Color. Body concolorous, pale sordid brown, including scutellum. Irregular obscure dark-brown markings along the costal margin of hemelytra and along the line between corium and clavus. These may be reduced in the male. Metanotum and dorsum of abdomen yellowish with a dark marking on the second, third and fourth and part of the fifth segments. Underside of body black with pale-brown hairs. In some specimens the abdominal venter may be green in color.

Structural Characteristics. Body comparatively stout. Head rather large with large eyes; vertex narrow at base; anterior breadth of vertex : synthlipsis :: 8:3. Pronotum transverse, lateral margins divergent, the lateral ledges more oblique and shorter than in *N. glauca* Linné. Scutellum much shorter than in *N. glauca* Linné and more strongly narrowed toward the apex. Membrane divided into two nearly equal parts along the median longitudinal line, the apex of the basal portion is more angularly and more posteriorly projecting than that of the apical half. Mesotrochanter rounded. The male genital capsule provided with a finger-like projection. The clasper as shown in figure 8, Plate XVII. (See, also, figures 3 and 14.)

Location of Types. The author does not state the depository of the types.

Data on Distribution. Poisson described this species from ma-



TEXT FIGURE 2. A. *Notonecta pallidula* Poisson (= N. horvathi Esaki). B. *Notonecta glauca* Linn. Lateral view of the head and prothorax. L. = lateral ledge of pronotum. E = rear margin of the eye below the lateral ledge of pronotum. Compare lengths of E. & L. in figures A. & B. (Redrawn from Esaki.)

terial taken by M. H. Gauthier in North Africa, who found it living alone in the "oued Reghaia," but in company with *N. maculata* and *N. glauca* in the "oued Safsaf."*

Professor Teiso Esaki, who described this species under the name *N. horvathi*, studied a male and two females from Tangier that were in the National Museum of Natural History, Paris. Esaki says they were determined by Kirkaldy as *N. glauca* var. *maculata*. Poisson belives that Delcourt (1909) had seen this species from Spain, Portugal, Italy and North Africa, but had considered it to be *N. maculata*. Doctor Poisson informs me that Algeria and Morocco are the only records confirmed.

Notonecta canariensis Kirkaldy 1897

Color Plate IV, fig. 8; Plate XVII, fig. 10.)

1897. *N. glauca* var. *canariensis* Kirkaldy, Trans. Ento. Soc. London, 1897, pp. 420, 422 and 423.

1904. *N. glauca* var. *canariensis* Kirkaldy, Wien. Ento. Zeit, xiii, p. 132.

Size. Length, 14 mm. to 15 mm.; width of pronotum, 4.85 mm. to 5 mm.

Color. General color effect dark. Head, thorax and legs dark testaceous; an indefinitely V-shaped dark spot on the pronotum behind the vertex of the head. Femur with more or less definite longitudinal dark stripe. Venter, except the connexivum, nearly black. Scutellum black. Hemelytra brown almost completely submerged by irrorations (often suffused) that are very dark brown or bluish-black; membrane dark brown to bluish-black.

Structural Characteristics. Anterior outline of the head viewed from above flattened; vertex shorter than its anterior width; margin of vertex less convex and longer than the margin of an eye; anterior breadth of vertex : synthlipsis :: 2 + : 1. Pronotum slightly more than twice as long as the head; lateral ledge as seen from the side sigmoid and oblique, shorter than the rear margin of the eye below it. Scutellum longer than the pronotum. The ridge of the hemelytral suture : length of scutellum :: 13:16. Anterior lobe of membrane distinctly longer than the posterior lobe. Anterior trochanter of male with tubercle. Mesotrochanter not angulate. Anteapical tooth of femur large. Terminal abdominal sternite of female with lateral margins not concave and tip not plainly incised. First pair of gonapophyses probably moderately short. Male genital capsule as shown on Plate XVII.

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* Oued.—An arabic word signifying running water and which designates more particularly the courses of temporary streams in the Sahara. It becomes a part of the name of a great number of courses of water and localities.

Location of Types. In the Vienna Museum I found four specimens, three males and one female, labeled "O. Simony, 1888 Teneriffa" and, in addition, on one label is written "Barenco Nedalgo." I placed red cotype labels on these specimens, since they are the specimens studied and recorded by Kirkaldy.

Comparative Notes. Kirkaldy in his description wrote: "Notocephalon a trifle narrower than in the other forms. Hemelytra purple-black, obscurely irrorated with dark, rich castaneous, margins of hemielytral areas narrowly the same colour; anterior half of exocorium rich castaneous blotched with black, posterior half black. Membrane black. Pedes rufotestaceous, suffused with rich green."

This sturdy species is closely related to *N. maculata* Fabr. The mesofemural tooth is longer and stouter, the tibia bears a conspicuous elevation. The margin of the pronotum is more strongly ledged, especially on the front half; the abdomen without the orange-yellow band at base. The clasper of the male genital capsule slightly different.

Data on Distributions. The Canary Islands. Besides the cotypes the Vienna Museum has ten specimens labeled "Gomera" "Canar. Ins. Polatzek," and seventeen specimens labeled "Tenerife" "Canar. Ins. Polatzek."

Notonecta maculata Fabricius 1794

(Color Plate V, fig. 10; Plate XVI, fig. 7.)

1794. *N. maculata* Fabricius, Ento. Syst., iv, p. 58.

1799. *N. maculata* Coquebert, Ill. Icon. Ins., p. 38, tab. x, fig. 1.

1803. *N. maculata* Fabricius, Syst. Rhyng., p. 103.

1817. *N. maculata* Leach, Trans. Linn. Soc. London, xii, pt. 1, p. 12.

1824. *N. maculata* Curtis, Brit. Ento. (ed. 1.), I, pl. x. (Esaki says plate is in different volume in later editions.)

1843. *N. glauca* var. *maculata* Amyot et Serville, Hem., p. 453.

1845. *N. maculata* Herrich-Schäffer (fide Curtis) = *marmorea* H. S., Wanz. Ins. viii, p. 23, tab. cclvi, fig. 797.

1848. *N. maculata* Amyot, Ento. Franc, Rhynch., p. 338. (Name invalid.)

1865. *N. maculata* Douglas & Scott, Brit. Hem. I, p. 588.

1888. *N. glauca* var. *maculata* Fabr., Reuter, Synonymica Heteropterorum palaearcticorum *in*: Acta Societatis Scientiarum Fennicæ Tomus XV, p. 727.

1892. *N. glauca* var. *maculata* Saunders, Hem. Heter. Brit. Is., p. 329.

1897. *N. glauca* var. *maculata* Kirkaldy, Rev. d'Ento., xvi, pp. 222, 224.

1897. *N. glauca* var. *maculata* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 422.

1905. *N. glauca* var. *maculata* Hüeber, Jahresh. Ver. Vaterl. Natur. Württemberg, lxi 117.

1909. *N. maculata* Fabricius; Delcourt, Bull. Scientifique Fr. Belg. (7) xliii, p. 378 and pp. 389 and beyond.

1909. *N. glauca* var. *maculata* Oshanin, Verz. Palæ. Hem. 1, p. 975.

1910. *N. glauca* var. *maculata* Whittaker, Entomologist, xviii, p. 97. London. (Mating in Jan. near Winscombe, Somerset.)

1922. *N. maculata* Despax, Bull. Soc. Hist. Nat. Toulouse L., 1922, pp. 97-112, 19 figs. (morphology of genitalia.)

1923. *N. glauca* var. *maculata* Lundblad, Ento. Tidsk., 1922-23, p. 72.

1923. *N. maculata* Butler, Biol. Brit. Hem. Heter., p. 559.

1924. *N. maculata* Poisson, Bull. Biol. de France et Belgique, T. lviii (1924), Fasc. 1. (Many ref. and figs.)

1924. *N. maculata* Hale, Proc. Lin. Soc., New South Wales, xlix, pt. 4, p. 462. (Notes.)

1925. *N. maculata* Jaczewski, Ann. Zoöl. Mus. Polon. Hist. Nat., iv, p. 128, fig. 2.

1926. *maculata* Poisson, Bull. de la Soc. d'Hist. Nat. de l'Afrique du Nord., T. Dix-Septieme, p. 247, Nov., 1926. (Figures, head and protrorax.) (Also, p. 269, Dec., 1926.)

1926. *N. maculata* Fabr.; Poisson, Cpt. rend. Soc. Biol. Paris, Bd. 94, p. 562 and 1007 (Cytology.)

1927. *N. maculata* Fabr.; Poisson, Archives de Zoölogie Experimentale et General..., Tome 66, Fasc. 2. pp. 23-70. (Cytological study.)

1928. *N. maculata* Esaki, Annals & Mag. Nat. Hist., Ser. 10 ii, pp. 69, 70, 75.

1929. *N. maculata* Fabr.; Poisson, Bull. Soc. d'Hist. Nat. de l'Afr. du Nord, xx, pp. 112, 113.

1929. *N. maculata* Hutchinson, Annals of South African Mus., vol. xxv, pt. 3, p. 363.

1929. *N. maculata* Lindberg, Soc. Scient. Fennica Comment. Biologicæ, iii, 4, pp. 11,12. (Took species in Spain and Morrocco, and says in both flowing and standing water.)

1930. *N. maculata* Larsen, Entomologisk Tidskrift 1930, pp. 219-241 (fig. 2a, chorion of egg.)

1930. *N. maculata* Fabr.; Jones, H. P., *reprint* from The Entomologists Record, Vols. XL-XLII, p. 69.

1933. *N. maculata* Fabr.; Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.

1933. *N. maculata* Fabr., Poisson, Bull. de la Soc. Scien. de Bretagne, X., Fasc. III et IV (Reprint p. 2).

Referring to this species, also:

1800. *N. glauca* Schellenberg, Cimic. Helvet., p. 21, tab. x.

1803. *N. marmorea* Fabricius, Systema Rhyng., p. 103.

1826. *N. variegata* Leach et Risso, Hist. Princ. Prod. Europ. Mérid. (Risso), v, p. 216.

1835. *N. marmorea* Herrich-Schäffer, Nomencl. Ento., I, p. 63. (See Esaki, 1928.)

1840. *N. glauca* var. *marmorea* Blanchard, Hist. Nat. Ins., iii, p. 89.

1851. *N. fabricii* var. *umbrina* Fieber, Abd. Bohm. Gesel. Wis. (5), vii, p. 474.

1861. *N. fabricii* var. *umbrina* Fieber, Eur. Hem., p. 101.

1880. *N. glauca* var. *umbrina* Puton, Synop. Hém. Hétér. France, iii, p. 218.

1881. *N. glauca* var. *umbrina* Puton, Synopsis H m.-Heteroptera France *in*: Memoires de la Société des Sciences de l'Agriculture et des Arts, 4 Série, Tom. ix, p. 122.

1905. *N. glauca* var. *marmorea* Hüeber, Jahresh. Ver. Vaterl. Natur. Württemberg, lxi, p. 116.

1907. *N. umbrina* Delcourt, Comptes Rendus des Séances et Memoires de la Société de Fr. Biologie, lxii, pp. 11-13. (Eggs in October to January on supports.)

1909. *N. marmorea* Kuhlgatz, Süsswasserf. Deutschl. (Brauer), vii, p. 81.

Size. Length, 12.6 mm. to 15.6 mm.; width of pronotum, 4.5 mm. to 5.4 mm., an astonishing variation! My smallest specimen is a male from Jericho, and the largest a female from Oran (Algeria). I have a specimen from Paris that attains the maximum length but not quite the width.

Color. An orange-red or orange-yellow species irrorated with brownish-red and blackish-brown. Anterior half of pronotum, head, limbs and connexivum of usual color, often suffused with green. Scutellum black. Metanotum orange-yellow with a large blackish blotch bordering the basal half of the scutellar margins. First abdominal dorsum orange-yellow, second to fourth black (the fourth narrowly orange-yellow apically) fifth and beyond, orange-yellow.

The hemelytral markings variable, the dark areas often coalescing at the distal inner angle of the corium.

Structural Characteristics. Anterior outline of head, viewed from above, flattened; vertex shorter than its anterior width; margin of vertex less convex and longer than the margin of an eye; anterior breadth of vertex : synthlipsis :: 2 + : 1. Pronotum slightly more than twice as long as the head; lateral ledge, as seen from the side, sigmoid and oblique, shorter than the margin of the eye below it. Scutellum longer than the pronotum. The ridge of the hemelytral suture : length of scutellum :: 13:18—. Anterior lobe of membrane a little longer than the posterior lobe. Anterior trochanter of male with very slight inconspicuous tubercle. Mesotrochanter not angulate. Anteapical tooth of femur of normal size (not large as in *N. canariensis* Kirk.). Terminal abdominal sternite of female with lateral margins slightly concave and tip shallowly incised. First pair of gonapophyses moderately short. Male genital capsule as shown on Plate XVI.

Location of Types. Delcourt says the types are in the Paris Museum.

Comparative Notes. This species differs from other common European species in having a head that is broad and truncate in front, in having a mottled brown color and in having the last ventral abdominal sternite of the female not compressed just before the tip. In this regard it agrees with *N. pallidula* Poisson, from which it is distinguished as shown by Poisson in his description.

Biological Notes. Delcourt, 1907, says this species attaches its eggs to the surface of some support in the water. The egg-laying period is from October to January. By keeping some eggs at a temperature of from 0 to 8 degrees they were held from October to following September. At 18 degrees they hatched in 20 days. Whittaker records the mating on January 14 in Summerset, England.

Data on Distribution. Doctor Poisson has been kind enough to give me the following information: Denmark, Holland, Belgium, England (West and South), Iberian Peninsula, North Africa (Algeria and Morocco), Egypt, Macedonia, Greece, Italy, Corsica, Central Europe, West and Southwest of Persia. My own records include the following: Paris, France; La Galle, Le Boul; Algeria; Phillippeville, Le Boul; Brindisi, J. Sahlb; Egypt, G. Fallou; Sardinia, A. H. Krausse; Morocco, G. Buchet, 1903 (Paris Mus.), Pushire, Persia; Karab, 23, 1931, VII, Alban. Exp. 1918. (Vienna Mus.); Baluchistan, Quetta, Pond in Res. Garden, Sta. No. 3, 11-10-18. B. S.; Shisba R. Pond 6,640 ft., 8 II, 96 Pamir Exp. (Indian Mus.).

Notonecta meinertzhageni Poisson 1934

N. meinertzhageni Poisson, Annals & Mag., Nat. Hist. (10) xiii p. 170-173 (with text figures).

Size. Length, 15 mm.; width of pronotum, 5.7 mm.*

Color. An orange-red and black species with pattern same as *N. chinensis* Fallou. (See Color Plate IV, fig. 1.)

Structural Characteristics. Anterior outline of head, viewed from above, flattened; the anterior outline of vertex slightly produced medianly; vertex shorter than its anterior width; margin of vertex less convex and about equal to anterior margin of the eye; anterior breadth of vertex : synthlipsis :: 37:17. Pronotum slightly more than twice as long as the head; lateral ledge, as seen from the side, sigmoid and oblique, shorter than the margin of the eye below it; anterolateral angles obtuse. Anterior trochanter of male with very slight inconspicuous tubercle. Mesotrochanter rounded. Male genital capsule resembles that of *N. maculata* Fabr. The clasper has a slight angle or projection on caudal margin. Poisson's drawing shows lateral edge of pronotum straight.

Location of Types. In British Museum and in collection of Doctor Poisson.

Data on Distribution. Described from specimens labeled "Ahaggar Mts., 1931, col. Meinertzhagen."

Notonecta arabiensis Hungerford 1926

(Color Plate V, fig. 1)

1926. *N. arabiensis* Hungerford, Annals Ento. Soc. of Amer., xix, No. 3, p. 280.

Size. Length, 16 mm.; width across the eyes, 4 mm.; width across the thorax, 6 mm.

Shape. Robust.

Color. Head, pronotum, connexivum and limbs yellow. Scutellum black, rear margin of pronotum somewhat darkened. Apical portion of wing membrane dark, remainder of membrane, corium, and clavus brick red with some faint irregular blackish blotches. Venter blackish, midventral keel slightly and abdominal margins plainly yellow.

Structural Characteristics. Head short. Anterior outline of the head, viewed from above, flattened. Vertex considerably shorter than its anterior width, margin of vertex nearly straight, curving at its lateral margins and nearly equal in length to the frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 19:10. Pronotum arched and at least three times as long as the head; lateral margins strongly divergent and straight; anterior angles normal; lateral ledge, as seen from the side, slightly sigmoid and oblique and a trifle shorter than the rear margin of the eye below it. Scutellum a little longer than the pronotum or the ridge of the hemelytral suture. Lobes of membrane about equal. Legs stout. Mesotrochanter rounded. Terminal abdominal sternite of female quite large and but slightly constricted before the tip, which is not notched.

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* This short description made from a paratype belonging to the British Museum.

Location of Types. Described from two females taken in Arabia and belonging to British Museum. These are designated as holotype and paratype. It is to be hoped that male specimens may be found to enable us to figure the male genital capsule.

Comparative Notes. These specimens are of the same size and color as *N. violacea* Kirkaldy. From this species they differ, however, in having a broader, shorter head, wider synthlipsis, and less flattened lateral margins of pronotum as seen from above. Shorter, blunter mesofemoral tooth. No prominence on caudal margin of mesotibia just distad to femoral tooth when the limb is flexed. *Notonecta violacea* Kirkaldy is provided with one. The last abdominal sternite of female is not conspicuously constricted near its tip as in *N. violacea* Kirkaldy. I have before me Kirkaldy's type, a male from Catcin Cauri, Birmania.

Notonecta violacea Kirkaldy 1897

(Color Plate IV, fig 11; Plate XVII, fig. 11.)

1897. *N. montandoni* Kirk. var. *violacea* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 418.

1904. *N. montandoni* Kirk. var. *violacea* Kirkaldy, Wien. Ento. Zeit, xxiii, p. 132 (lists only).

1915. *N. violacea* Kirk.; Hungerford, Annals Ento. Soc. Am., xviii, p. 418 (notes).

Size. Length, 17.2 mm.; width across pronotum, 6.5-7 mm.

Shape. Large, plump species.

Color. Head, anterior part of pronotum and limbs dark testaceous; front of head and limbs may be greenish; scutellum black; hemelytra including basal two-thirds of anterior lobe of membrane reddish, faint-violet in background, rest of membrane brownish-black. Base of hind wing and marginal vein red.

Structural Characteristics. Anterior breadth of vertex : synthlipsis :: 9:3; lateral margins of pronotum nearly straight but faintly sinuate; anterior angles not acute. Scutellum longer than pronotum 7— : 5). Lobes of membrane equal in length. Anterior trochanter of male without hook or dentation. Mesotrochanter rounded (perhaps faintly angulate). Mesofemur with usual anteapical tooth. Mesotibia with denticulate prominence on rear margin. Terminal abdominal sternite of female large and strongly constricted near tip, which is entire. First pair of gonapophyses long. Male genital capsule as shown on Plate XVII, fig. 11.

Location of Types. Described by Kirkaldy as a variety of *N. montandoni* Kirk. He gives the habitat as: "Burma: 'Catcin Cauri,' " (Fea Ag. Nov., 1886) and specimens as being in Montandon's, Hamburg Mus. and his own collection. I have found specimens in the Kirkaldy collection at the U. S. N. M. labeled "Catcin Cauri Birmania Fea, Ag. Nov., 1886" and determined by Kirkaldy as *N. montandoni* var.

Comparative Notes. Although described as a variety of *N. montandoni,* it is a distinct species which is related to *N. arabiensis* Hungerford and *N. amplifica* Kirit., from which it may be distinguished by the key presented below.

A. Mesotibia with denticulate prominence on rear margin.................... *N. violacea.*
AA. Mesotibia without denticulate prominence on rear margin.
  B. Rear margin of middle tibia at base emarginate and detinculate. Last abdominal sternite of female strongly constricted...................... *N. amplifica.*
  BB. Rear margin of middle tibia at base straight and not denticulate. Last abdominal sternite of female not strongly constricted.................. *N. arabiensis.*

Notonecta glauca glauca Linné 1758

(Color Plate IV, fig. 10; Plate XVII fig. 7.)

1758. *N. glauca* Linné, Syst. Nat., ed. x., p. 439.
1778. *N. glauca* Goeze, Ento. Beytr., ii., p. 166.
1789. *N. glauca* Gmelin, Syst. Nat. (Linné), ed. xiii, p. 2118.
1794. *N. glauca* Fabricius, Ento. Syst., iv, p. 57.
1803. *N. glauca* Fabricius, Syst. Rhyng., p. 102.
1804. *N. glauca* Panzer, Schäfferi Icon. Ins. Ratisbon., Enum. Syst. i., p. 48.
1817. *N. glauca* Leach. Trans. Linn. Soc. London, xii, pt. i., p. 13.
1829. *N. glauca* Fallén, Hem. Svec., p. 177.
1835. *N. glauca* Burmeister, Handb. Ento., ii, p. 190.
1835. *N. glauca* Herrich-Schäffer, Nomencl. Ento. i, p. 63.
1840. *N. glauca* Spinola, Essai Ins. Hem., p. 59.
1840. *N. glauca* Blanchard, Hist. Nat. Ins., iii, p. 88, tab. Hém. i, fig. 2.
1843. *N. glauca* Amyot et Serville, Hém., p. 452.
1845. *N. glauca* Herrich-Schäffer, Wanz. Ins. viii, p. 23.
1860. *N. glauca* Flor, Rhynch. Livl. i, p. 772.
1865. *N. glauca* Douglas et Scott, Brit. Hem. i, p. 587, tab. xx., fig. 4.
1869. *N. glauca* Linné; Stal, Hemiptera Fabriciana, p. 136.
1875. *N. glauca* Regimbart, Ann. Soc. Ento. Fr. (5), pp. 204, 205, pl. IV (oviposition).
1878. *N. glauca* Snellen van Vollenhoven, Hem. Heter. Neerland, p. 347, tab. xx, figs. 2, 2a.
1880. *N. glauca* var. *glauca* Puton, Synop. Hém. Hétér. France, iii, p. 217.

1881. *N. glauca* var. *glauca* Linn. Puton. Synopsis, Hém.-Hétér. France *in*: Memoires de la Société des Sciences de l'Agriculture et des Arts, 4° Série, Tom. ix, p. 121.

1888. *N. glauca* Reuter, Rev. Synomymica Heter. Palaearcticorum ... *in* Acta Soc. Scient. Fennicæ Tom xv, p. 725.

1890. *N. glauca* Pédaschenco, Rev. Sci. Nat. St. Petersb. I, pp. 358-362 (embryology).

1892. *N. glauca* Saunders, Hem. Heter. Brit. Is., p. 329.

1897. *N. glauca* var. *glauca* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 421.

1897. *N. glauca* Linné; Kirkaldy, Rev. Ento. France, XVI, pp. 222-224.

1897. *N. glauca* Linné; Horvath, Rev. Ento. France, 1897, p. 94.

1898. *N. glauca* Linné; Kirkaldy, Ento. Mo. Mag., ix, (2d), p. 173 (oviposition).

1900. *N. glauca* Linné; Puton, Revue D'Entomologie, xviii, p. 80.

1902. *N. glauca* Pantel and de Sinéty, Compt. Rend. Ac. Sc., Paris, cxxxv.

1904. *N. glauca* Linné; Kirkaldy, Wien. Ento. Zeit, xxiii, p. 132.

1905. *N. glauca* Prowazek, Zeitschr. Insbiol., I, p. 63 (migration).

1905. *N. glauca* Hueber, Jahresh. Ver. Vaterl. Naturk. Württemberg, lxi, p. 113.

1906. *N. glauca* Pantel and de Sinéty, La Cellule, xxiii, pp. 87-303, 8 plates (cytology).

1906. *N. glauca* Poulton, Trans. Ento. Soc., 1906, pp. 403-408 (Preying on Donacia).

1907. *N. glauca* Linné; Delcourt, Comptes Rendus des Séances et Memoirs de la Société de Fr. Biologie, lxii, pp. 11-13. (Mates and oviposits in spring time).

1909. *N. glauca* Linné; Delcourt, Comptes Rendus des Séances et Mem. Soc. de Biologie, Paris, lxvi, pp. 589-591.

1909. *N. glauca* Oshanin, Verz. Palæ, Hem. i, p. 974.

1909. *N. glauca* Kuhlgatz, Süsswasserf. Deutschl. (Brauer), vii, p. 79, fig. 68.

1912. *N. glauca* Jensen-Haarup, Danmarks Fauna, xii (Taeger), p. 31, fig. 10.

1912. *N. glauca* Wefelscheid, Zoöl. Jahrb. (Jena), xxxii, pp. 391 and 407.

1912. *N. glauca* Hoppe, Zoöl. Jahrb. Jena Abt. f. allg. Zoöl., xxxi, pp. 189-244, 2, tables (respiration).

1915. *N. glauca* Linné; Wesenberg-Lund., Insektlivet I. Ferske Vande, pp. 118-125.

1916. *N. glauca* Browne, Jl. of Morph, xxvii, p. 123 (Cytology).

1917. *N. glauca* Linné; Hungerford, Ento. News, xxviii, p. 268.

1917. *N. glauca* Linné; Hungerford, Ento. News, xxviii, p. 174.

1918. *N. glauca* Linné; Hungerford, Ento. News, xxix, p. 241, pl. xv, fig. 6 (figures ovipositor).

1919. *N. glauca* Linné; Hungerford, K. U. Sci. Bull., xi, pp. 43, 166, 169, 179, 180, 181, 186, 190, 255, 256, 258, 259, 262, 263, 265.

1919. *N. glauca* Linné; Hungerford, K. U. Sci. Bull., xi, p. 329. (Error in drawing).

1922. *N. glauca* Linné; Lehmann, Zoöl. Jahrb. Jena, xlvi, pp. 121-158, 2 pl. (Biology of).

1922. *N. glauca* Linné; Despax, Bull. Soc. His. Nat. Toulouse, vol. L, pp. 97-112, figs. 7-12 and 17-19. (Male and female genitalia.)

1923. *N. glauca* Linné; Lundblad, Ento. Tidsk., p. 71.

1923. *N. glauca* Linné; Hale, Rec. S. Aust. Mus., ii, No. 3, p. 418.

1923. *N. glauca* Butler, Biol. Brit. Hem. Heter., pp. 558, 559.

1924. *N. glauca* Linné; Poisson, Bull. Biol. de France et Belgique, lviii, pp. 58, 62-65, 69-71, 73-76, 79, 110, 112, 113, 114, 185, 186, 188, 191, 276-278, 290, 295, 298, 300; pl. l, fig. 1, pl. 3, figs. 3-5.

1925. *N. glauca* Poisson, Bull. Soc. Ento. France, p. 328, fig. 2.

1925. *N. glauca* Linné; Hungerford, Annals Ento. Soc. Am., xviii, p. 418.

1926. *N. glauca* Linné; Poisson, Bull. de la Soc. d'Hist. Nat. de l'Afrique du Nord., vol. xvii, p. 269.

1926. *N. glauca* Kerkis, Revue Russe d'Ento., xx p. 300 (internal sex organs.)

1928. *N. glauca* Linné; Esaki, Annals and Mag. Nat. Hist., ser. 10, vol. II, p. 67.

1929. *N. glauca* Linné; Lindberg, Soc. Scient. Fennica Comment. Biologicae III, 4, p. 11 (Spain).

1929. *N. glauca* Linné; Hutchinson, Annals of South African Mus., xxv, pt. 3, p. 363.

1930. *N. glauca* Linné; Larsen, Ento. Tidsk., 1930, p. 219.

1930. *N. glauca* Linné; Jones *in* Reprint from The Entomologists Record, vols. XL-XLII, p. 69.

1933. *N. glauca glauca* Linné; Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.

1933. *N. glauca glauca* Linné; Poisson, Bull. de la Soc. Scien. de Bretagne X. (Reprint p. 2.)

Referring to this species, also:

1766. *N. prima* Schäffer, Icon. Ins. Ratisb, I, pt. 1, tab. xxxiii, figs. 5 and 6. (Esaki says name "invalidum et nudum.")

1848. *N.* var. *glauca* Amyot, Ento. France, Rhynch, p. 337, tab. iii, fig. 54. (Esaki says "nom. invalidum.")

1851. *N. fabricii* var *glauca* Fieber, Abh. Bohm. Gesel. Wis. (5), vii, p. 474. (= Rhynchotographien).

Size. Length, 14 mm. to 16 mm.; width of thorax, 4.8 mm. to 5.1 mm.

Color. Typically yellowish-brown with black scutellum and brownish-black maculations along the costal margin of the hemelytra; venter and abdominal dorsum more or less dark.

Structural Characteristics. Head moderately convex, vertex shorter than its anterior width; margin of vertex less convex than margin of the eye; margin of vertex nearly as long as frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 2:1; head less than half as long as pronotum. Pronotum with lateral margins moderately divergent and slightly concave, more so in female than in the male; anterior angles normal; lateral ledge, as seen from the side, sigmoid, caudal end turned up beneath the humeral angle, which is not prominent, somewhat oblique and as long as the rear margin of the eye below it. Scutellum longer than pronotum. Anterior lobe of membrane longer than the posterior. Anterior trochanter of male with slight protuberance. Mesotrochanter rounded. Terminal abdominal sternite of female constricted near the tip, which is bluntly pointed. First pair of gonapophyses of female moderately long. Male genital capsule as shown on plate XVII, fig. 7.

Location of Type. Kirkaldy gives the location of the type "? Upsala." I did not find it there. I found, however, a female, in the Linnean Society's collection in London. Delcourt [22] reported the type as being in London.

Discussion. This species name has been applied to so many forms that one must take the references with some reservation. Kirkaldy placed as varieties of this species the following: *N. marginata* Müller, *N. canariensis* Kirk., *N. marmorea* Fabr. and *N. maculata* Fabr. I have examined most of the material mentioned by Doctor Kirkaldy in his "Revision of the Notonectidæ" and feel that his conception of this species was quite confused. Doctor Delcourt and others have attempted to clear up the specific relationships of the European forms.

Under "*Notonecta* var. 1 *glauca* L.," Kirkaldy included specimens from brackish water near Gravesend (England). These specimens belong to *N. viridis* Delcourt. The specimens in the Kirkaldy collection bearing the label Gravesend are certainly Delcourt's species.

Doctor Kirkaldy, under this variety (p. 421 of his Revision), says: "From Maie-Nousky, Erzerum (Vienna Mus.) I have seen two specimens resembling in color and disposition of the apical hemielytral fascia, the typical form of *N. americana* Fabr." I have these two specimens before me; they are from Mali, not "Maie," and I have seen eight more in the Vienna Museum. They are, it seems to me, a little larger than typical *N. glauca* Linné. The broad, black band across the hemelytra is a striking characteristic of all of them. (See Color Plate V, fig. 3.) A specimen like these labeled "Monts Baktyaris, 1500 a 4500 m. J. de Morgan 1904" is in the Paris Museum.*

Data on Distribution. Since Doctor Kirkaldy's conception of this species was rather vague, his idea of distribution is not acceptable. Doctor Poisson has been kind enough to write me concerning his knowledge of this species. He says it is widely distributed over Europe and is common in France, but that its southern distribution should be more precisely ascertained. This, I think, applies also to the Asiatic records. The specimens in our own collection came from England, France, Finland and Germany.

Biological Notes. This species has been studied by various European workers. Regimbart,[72] 1875, reported that the eggs are inserted in the stems of aquatic plants. Wesenberg-Lund [84] says the eggs are inserted in plant tissues, air filled, not water-soaked plant parts. He further says that eggs laid in April and May are hatched in the course of three to six weeks. The nymphs pass through five moults, and after five or six weeks they are fully developed. Mating has been observed in late summer, but the usual time is early spring. These insects are good fliers and in the fall seek ponds rich in plant life and overwinter there as adults. Delcourt [22] has reared this species and studied the results of crosses of forms of different color patterns.

Notonecta glauca poissoni new subsp.

(Color Plate V, fig. 3)

This form is larger than the average *N. glauca glauca* Linn. and has a large transverse band across the hemelytra, as shown in the colored figure. Doctor Kirkaldy mentions specimens belonging to the Vienna Museum (see his Revision, p. 421) that came from Mali-Nousky, Erzerum, and says "they resemble in color and disposition of the apical hemielytral fascia the typical form of *N. americana* Fabr." The two specimens mentioned by Kirkaldy are before me. I have seen eight more in Vienna. Paris Museum has a specimen labeled "Monts Baktyaris, 1500 a 4500 m. J. de Morgan 1904."

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* I have named these *N. Glauca poissoni*.

I propose to make the series in Vienna the types and will mark the holotype, allotype and paratypes.

Notonecta glauca hybrida Poisson* 1933

1933. *N. glauca hybrida* Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.
1933. *N. glauca hybrida* Poisson, Bull. de la Soc. Scien. de Bretagne X, Fasc. III et IV (Reprint, p. 2.)

This subspecies is, in color, intermediate between *N. glauca* Linn. and *N. maculata* Fabr. The hemelytra are reddish or brownish, more or less strongly maculated, presenting at the base either one pale longitudinal band on the clavus or two bands, one on clavus and the other on the corium. Structurally this form is like *N. glauca* Linn. and the females may be placed at once by examining the last abdominal sternite, which is strongly constricted before the tip, a character like *N. glauca* Linn. and not like *N. maculata* Fabr. Doctor Poisson gives the distribution as Southern France, Iberian Peninsula and North Africa. I have two species sent me by Doctor Poisson. One is labeled "Banyuls" and the other "Pouade."

Notonecta glauca fulva de la Fuente 1898

(Color Plate V, fig. 11; Plate XVI, fig. 6.)

1898. *N. glauca* var. *fulva*, de la Fuente, Actas Esp. Hist. Nat., xxvi, p. 130.
1927. *N. maculata* var. *fulva*, Hutchinson, Annals & Mag. Nat. Hist. (9), xix, p. 375.
1928. *N. glauca* var. *fulva*, Poisson, Bull. Soc. Ento. France, No. 6, p. 106.
1928. *N. maculata* var. *fulva*, Hutchinson, Ento. Mont. Mag., lxiv, p. 35.
1928. *N. maculata* var. *fulva*, Esaki, Annals & Mag. Nat. Hist. (Ser. 10), vol. ii, pp. 70 and 75.

J. M. de la Fuente, in a paper entitled "Datos para la fauna de la provincia de Cindadreal *in Actas* of the "Anales de la Sociedad Española de Historia Natural, 1897, p. 130," described this variety as follows: "*Notonecta glauca* L. v. *fulva:* Elytra fulva, sine maculis, una tantum levissima excepta in basi suture locata."

The type of this variety has not been reëxamined since it was described, and I do not know its location. It has been assumed by Hutchinson that it is an immaculate variety of *N. maculata* Fabr. Mr. Hutchinson says there are specimens from Naples and Southern Tunisia that fit Fuente's *fulva* and which are a variety of *N.*

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* This may be *N. octopunctata* Goeze, 1878, Ento. Beytr., ii, p. 169. See Esaki, Annals and Mag. Nat. Hist. (Ser. 10), vol. ii, p. 76, for comment on *N. secunda* Schäffer.

maculata Fabr. and not *N. pallidula* Poisson. Esaki reports specimens taken by W. E. China in Guernsey, Channel Islands, August, 1927, that should be assigned to *N. maculata* var. *fulva* Fuente.

Mr. China, in 1928, gave me seventeen specimens labeled "Guernsey, August, 1927, W. E. China." All but one of these are typical *N. maculata* Fabr. There is one male, however, that I have taken to be *N. maculata fulva* Fuente, and figured in Color Plate V. This specimen, besides having a little differently shaped head and straighter lateral margins of prothorax, has the dorsum of the abdomen black (lacking the orange band characteristic of all the other specimens) and the anteapical tooth of middle femur small. I have no female specimens from Guernsey. An examination of the last abdominal sternite* of female would show at once whether this form should be assigned as subspecies of *N. maculata* Fabr., as Hutchinson and Esaki assume, or to *N. glauca* Linn., as Poisson believes. Doctor Poisson has recently written me that he has attempted to locate Fuente's type without success and considers the specimens from Guernsey as belonging to *N. glauca rufescens* Poisson. It is in deference to his opinion that I transfer Fuente's species to *N. glauca fulva*, but strongly suspect that *N. glauca rufescens* Poisson will prove to be *N. glauca fulva* Fuente.

Notonecta glauca rufescens Poisson 1933

(Color Plate V, fig. 11.)

1933. *N. glauca rufescens* Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.

1933. *N. glauca rufescens* Poisson, Bull. de la Soc. Scien. de Bretagne X, Fasc. III et IV, 1933. (Reprint, p. 3.)

This subspecies has the structural characters of *N. glauca* Linn. and is distinguished by the almost immaculate reddish hemelytra (see key to species). Since *N. glauca fulva* Fuente must have a similar appearance it may be the same thing. Doctor Poisson has most kindly sent me specimens from Banyuls and Salses.

Notonecta obliqua obliqua Gallén 1787

(Color Plate IV, fig. 6; Plate XVII, fig. 9)

1787. *N. obliqua* Gallén. Mus. Nat. Acad. Upsal., pt. v, p. 61 (Esaki).

1897. *N. obliqua* Thunb.; Kirkaldy, Trans. Ento. Soc. London, p. 419. (According to Esaki, Kirkaldy credited wrong author.)

1928. *N. obliqua* var. *obliqua* Esaki, Ann. & Mag. Nat. Hist., ser. 10, vol. ii, p. 68.

1929. *N. obliqua* var. *obliqua* Hutchinson, Ann. South African Museum, XXV, pt. 3, p. 363.

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* I have asked Mr. China, of the British Museum, to examine the females from Guernsey with reference to this point. He replies: "No females are present."

1933. *N. obliqua* Gallén; Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.

1933. *N. obliqua obliqua* Gallén; Poisson, Bull. de la Soc. Scien. de Bretagne X, Fasc. III et IV (Reprint p. 3). (Also, Fasc. I et II, Reprint, p. 29, egg of).

Referring to this species, also:

1794. *N. furcata* Fabricius, Ento. Syst., iv, p. 58.

1799. *N. furcata* Coquebert, Ill. Icon. Ins., p. 38, tab. x, fig. 2.

1803. *N. furcata* Fabricious, Syst. Rhyng., p. 102.

1807. *N. furcata* Haworth, Trans. Ento. Soc. London, i, p. 98.

1817. *N. furcata* Leach, Trans. Linn. Soc. London, xii, pt. 1, p. 12.

1826. *N. melanota* Leach and Risso, Hist. Princ. Prod. Eur. Mérid. (Risso), v, p. 215 (Esaki).

1829. *N. furcata* Fallén, Hem. Svec., p. 178.

1835. *N. glauca* var. *a* Burmeister, Handb. Ento., ii, p. 190.

1835. *N. furcata* Herrich-Schäffer, Nomencl. Ent., i, p. 63.

1840. *N. fuscata* (!) Spinola, Essai, Ins. Hem., p. 59.

1840. *N. glauca* var. *furcata* Blanchard, Hist. Nat. Ins., iii, p. 89.

1843. *N. glauca* var. *furcata* Amyot et Serville, Hem., p. 453.

1845. (sine nom.) Herrich-Schäffer, Wanz. Ins., viii, p. 24, No. 4.

1848. *N.* var. *furcata* Amyot, Ento. Franc., Rhynch. p. 337, nom. invalid.

1851. *N. fabricii* var. *furcata* Fieber, Abh. Böhm. Gesel. Wis. (5), vii., p. 474.

1861. *N. fabricii* var. *furcata* Fieber, Eur. Hem., p. 101.

1865. *N. glauca* var. *furcata* Douglas et Scott, Brit. Hem., i, p. 588.

1880. *N. glauca* var. *furcata* Puton, Synop. Hém. Hétér. France, iii, p. 217.

1881. *N. glauca* var. *furcata* Fabr.; Puton, Synopsis Hém. Hétér. France *in*: Memoires de la Société des Science de l'Agriculture et des Arts, 4° Série, Tom. IX, p. 121.

1888. *N. glauca* var. *furcata* Reuter, Syn. Heterop. palæarcticorum *in*: Acta Soc. Scient. Fennicæ, Tomus XV, p. 727.

1892. *N. glauca* var. *furcata* Saunders, Hém. Hétér. Brit. Is., p. 329, tab. xxxi, fig. 2.

1897. *N. glauca* var. *marginata* Müller; Kirkaldy, Trans. Ento. Soc. London, 1897, p. 421 (Esaki says name applied to a corixid).

1904. *N. fabricii* var. *fasciata* (!), Kirkaldy ("fide Fieber, 1861"), Wien. Ent. Zeit., xxiii, pp. 95, 132.

1905. *N. glauca* var. *furcata* Hueber, Jahresh. Ver. Vaterl. Naturk. Württemberg, lxi, p. 117.

1906. *N. glauca* var. *marginata* Distant, Faun. Brit. Ind., Rhynch. iii, p. 41.

1907. *N. furcata* Fabr.; Delcourt, Comptes Rendus des Seances et Memoires de la Société de Fr. Biologie, lxii, pp. 11-13.

1909. *N. furcata* Fabr.; Delcourt, Bull. Scient. Fr. et Belge, xliii, pp. 373, 461 (numerous references).

1909. *N. glauca* var. *furcata* Oshanin, Verz. Palæ. Hém., i, p. 975.

1909. *N. glauca* var. *furcata* Kuhlgatz, Süsswasserf. Deutschl. (Brauer), vii, p. 81.

1915. *N. glauca* var. *furcata* Fabr.; Bollweg, Verhandlungen des Naturhistorischen Vereins der Preussischen Rheinlande und Westfalens 71. Jahrgang 1914, p. 174.

1922. *N. glauca* var. *furcata* Fabr.; Despax, Bull. Soc. Hist. Nat. Toulouse 1922, pp. 97-112.

1923. *N. glauca* var. *furcata* Fabr.; Lundblad, Ento. Tidskrift 1922-1923, p. 72.

1923. *N. furcata* Butler, Biol. Brit. Hém. Hétér., p. 559.

1929. *N. furcata* Hutchinson, Annals of South African Museum, xxv, pt. 3, p. 363.

1930. *N. furcata* Jones, *in* Reprint from the Entomologists Record, XL-XLII, p. 69.

1930. *N. furcata* Larsen, Entomologisk Tidskrift, 1930, pp. 219-221.

Size. Length, 16 mm.; width of pronotum, 5.1 mm. to 5.4 mm. A large species that may vary both ways from above measurements.

Color. A black and luteous species. Head and limbs of usual color; scutellum black; hemelytra black or blue-black with two oblique luteous stripes on basal half; hemelytral suture pale; venter and abdominal dorsum dark.

Structural Characteristics. Head not prominent. Anterior outline of head moderately convex; vertex shorter than anterior width; margin of vertex less convex than margin of the eye; margin of vertex longer than the frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 2:1. Pronotum more than twice as long as the head; lateral margins moderately divergent and slightly concave; anterior angles normal; lateral ledge, as seen from the side, slightly sigmoid, nearly horizontal and longer than rear margin of eye below it. Scutellum longer than the pronotum. Anterior lobe of membrane slightly longer than posterior. Anterior trochanter of male with slight elevation that is obscured by a more or less dense pilosity. Mesotrochanter rounded. Terminal abdominal sternite of female large, constricted near the tip, which is bluntly pointed. First pair of gonapophyses moderately long.

Location of Type. Unknown to me. I did not see it in the Museum at Upsala. Delcourt reports type of *N. furcata* Fabr. to be in Paris.

Discussion. This species is better known under the names *N. furcata* Fabr.; *N. marginata* Müller, or treated as a variety of *N. glauca* Linn. Doctor Esaki, 1928, says, "Kirkaldy identified this species, *Notonecta furcata*, auct., with *Notonecta marginata* Müller." Müller writes: "*N. marginata* elytris nigris: margine suturaque luteis" [Zoöl. Dan. Prodr. p. 104 (1776)]. This description does not agree with this species, and although *"furcata"* is mentioned by Jensen-Haarup in Danmarks Fauna, I have no verification of its occurrence; in any case it is not a common form in Denmark, so that I do not agree with Kirkaldy's opinion. On the other hand, *marginata*, Müller, is most probably identical with one of the *Corixa* (sensu lat.) species, as the description covers all the forms which are common in Denmark, and *marginata* was placed by Müller between *Notonecta striata* and *N. minutissima,* both of which are Corixids. The British Museum copy of Müller's work originally belonged to J. C. Schiödte, the well-known Danish hemipterist, and among his annotations he writes of *Notonecta marginata* "= *Corixa hellensi*, Fallén, 183," so that there is little doubt as to the generic identity of Müller's species."

Doctor Esaki, 1928, also says: "The name *obliqua* was referred to "Thunberg DD. Ac. Mus. Upsal., p. 61" by Kirkaldy. The correct title of this book is: "Museum Naturalium Academiæ Upsaliensis (præside C. P. Thunberg)," and different parts were worked out by different authors. Part V (pp. 59-68), "Donation Thunbergianæ

1785, Continuat. III," in which this species is included, was written by Olavus Gallén, not by Thunberg, and was published in 1787 (according to Hagen, Bibl. Ent., on December 5). His description is as follows: "Hemelytra nigris lineis duabus obliquis abbreviatis cinereis." This agrees quite well with *Notonecta furcata* Fabricius, and therefore I have synonymized the latter with *N. obliqua* Gallén. While Delcourt[22] found all color pattern gradations between this species and *N. glauca* Linn., and Despax[24] concludes that it is only a variety of *N. glauca* Linn., I am retaining them as distinct though closely related species and await the conclusions of Doctor Poisson, who has at his command much material and the advantage of recent morphological studies.

Data on Distribution. Northern and middle palæarctic. Doctor Poisson writes me that it is to be found in the east, north, northwest, west and central France, and that most typical form appears to be that from Normandy.

*Notonecta obliqua delcourti** Poisson 1933

1933. *N. obliqua delcourti* Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.

1933. *N. obliqua delcourti* Poisson, Bull. de la Soc. Scien. de Bretagne X, Fasc. III et IV. (Reprint, p. 3.)

This variety, Doctor Poisson says, is distinguished from *N. obliqua obliqua* Gallén by having in addition to the two typical bands on the hemelytra a large flavous spot beyond the corial band. I have not seen this variety.

Notonecta obliqua meridionalis Poisson 1926

(Color Plate V, fig. 5; Plate XVI, fig. 5)

1926. *N. furcata* Fabr. var. *meridionalis* Poisson, Bull. Soc. Hist. Nat. Afrique Nord, xvii, p. 240, November, 1926. (also p. 269, December).

1928. *N. furcata* Fabr. var. *meridionalis* Poisson, Bull. Soc. Ento. France, No. 6, p. 106.

1928. *N. obliqua* Gallén var. *meridionalis* Poisson; Esaki, Annals and Mag. Nat. Hist., ser. 10, vol. ii, p. 69.

1929. *N. obliqua* Gallén var. *meridionalis* Poisson; Hutchinson, Annals South African Museum, xxv, part 3, p. 363.

1933. *N. obliqua meridionalis* Poisson, Annales de la Soc. Ento. de France, Janvier, 1933.

1933. *N. obliqua meridionalis* Poisson, Bull, de la Soc. Scien. de Bretagne X, Fasc. III and IV. (Reprint, p. 3.)

Referring to this species, also:

1897. *N. marginata* Kirkaldy, Trans. Ento. Soc. London, p. 421 (Sind Valley, Kashmir).

1925. *N. furcata* Poisson, Bull. Soc. Ento. France, p. 270.

1925. N. *furcata* Poisson, Bull. Soc. Ento. France, p. 328, fig. 3.

Size. Length, 13.2 mm. to 15 mm.; width of pronotum, 4.8 mm. to 5.4 mm.

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* Poisson describes as a variety, not a subspecies.

Color. General facies darker than *N. obliqua* Gallén. Hemelytra nearly black except for a broad flavous line on the basal half of clavus. Some specimens may show a small flavous stripe or some maculations on the corium.

Structural Characteristics. While I cannot fix upon any very good external characters to separate this from *N. obliqua* Gallén, the lateral margins of the pronotum seem straighter and more divergent and as viewed from the side the pronotum more elevated in the rear. The claspers of the two males I have examined differ from those of *N. obliqua* as indicated on Plate XVI.

Location of Type. Not indicated in Poisson's description.

Comparative Notes. In naming this variety Doctor Poisson says that it is a little smaller than the typical *N. obliqua* Gallén and usually only presents one flavous line on the hemelytron, this is on the clavus. In *N. obliqua* Gallén there are two slightly diverging longitudinal flavous lines on the base of the dark hemelytra, one on the corium and the other on the clavus.

Data on Distribution. Doctor Poisson writes me that this species is around the Mediterranean region. Southern France, Iberian Peninsula, North Africa, Asia Minor, Greece, Macedonia, Albania and Italy. I have specimens before me labeled as follows: Tunisia, Tabarca and Ain Draham (Budapest Mus.); Sind Valley, Kashmir Det. by Kirkaldy as *N. glauca* L.; Mor. Sidi Dris de Barein G. Buchet 1903 (Paris Mus.); Constantine, J. Sahlb. Det. by Kirkaldy as *N. glauca* var. *marginata* Müll.; Zaguan, J. Sahlb.; Philippeville, Algerie, A. Thery.

Notonecta amplifica Kiritshenko 1930

(Color Plate V, fig. 4; Plate XVI, fig. 4)

1930. *N. amplifica* Kiritshenko, Annuaire du Musée Zoölogique de l'Academie des Sciences de l'U. R. S. S., 1930, pp. 434 and desc. on pp. 437-438, figs. 1, 2, 3, 4.

Size. Length, 17 mm. to 18.3 mm.; width across thorax, 6 mm. to 6.3 mm.

Shape. Robust.

Color. Head, pronotum, limbs and connexivum dark testaceous. Rear half of pronotum darkened by black beneath. Scutellum with basal two-thirds black mottled with pale yellowish spots. Tip pale. Hemelytra pale brown.

Structural Characteristics. Male head a little broader than that of female; anterior margin of vertex : synthlipsis : : 9 : 4.1. Pronotum somewhat arched, lateral margins slightly sinuate. Scutellum and elytral suture about equal in length. Anterior lobe of membrane very slightly longer than posterior. Anterior trochanter of male without hook or marked dentation. Middle leg as in *N. arabiensis*, but distal femoral tooth stouter and rear margin of tibia slightly emarginate and minutely denticulate. Terminal abdominal sternite of female strongly constricted. Male genital capsule as shown on Plate XVI, fig. 4.

Location of Types. Described from southeastern Siberia. Types in Petrograd, paratypes in University of Kansas Collection.

Comparative Notes. A large robust species related to *N. violacea* Kirkaldy and *N. arabiensis* Hungerford, see key under *N. violacea* Kirkaldy. Three specimens more slender and of luteous color from "Amur," in British Museum, were labeled by Doctor Kiritshenko as *N. lutea* var. *scutellaris*. The male genitalia shows them to be *N. amplifica* Kiritshenko.

Notes on Distribution. "Habitat in prov. Primorskaja Sibiriæ Orientalis: haud procul a Vladivostok (Sedanka, Tshernaja Rjetshka, Okeanskaja) et Novakievskoje in litore sinus Posjet. (27-27 ix 1928, Prinada leg.)"

Doctor Kiritshenko was kind enough to send me two specimens from Vladivostok.

Notonecta lutea Müller 1776

(Color Plate IV, fig. 7; Plate XVII, fig. 2)

1776. *N. lutea* Müller, Zoöl. Dan Prodr., p. 103.

1778. *N. lutea* Müller; Goeze, Ento. Beytr., II, p. 170.

1804. *N. lutea* Müller; Weber and Mohr, Naturh. Reise de. Schwed., p. 66 (Fieber).

1814. *N. lutea* Müller; Fallén, Hydroc. Nauc. Suec., p. 6 (Van Duzee).

1829. *N. lutea* Müller; Fallén, Hem. Svec., p. 178.

1851. *N. lutea* Müller; Fieber, Abh. Böhm. Gesel. Wiss. (5), vii, p. 473.

1860. *N. lutea* Müller; Flor, Rhynch. Livl., 1, p. 774.

1861. *N. lutea* Müller; Fieber, Eur. Hem., p. 100.

1875. *N. lutea* Müller; Sahlberg, Not. Sällsk. Fauna Fenn. Förh., xiv, p. 274 (Kirkaldy).

1879. *N. lutea* Müller; Puton, Synop. Heter, Fr., p. 218. (From Van Duzee, pagination of Separate.)

1881. *N. lutea* Müller; Puton, Synopsis des Hemipt.-Heteropt. de France 3° Partie. Memoires de la Société des Sciences de l'Agri. et des Arts de Lille, 4° Série, Tome ix, p. 122.

1888. *N. lutea* Müller; Reuter, Rev. Synom., p. 374, No. 351. (From Van Duzee—Pagination of Separate.)

1888. *N. lutea* Müller; Reuter, Revisio Synonymica Heteropterorum Palæarcticorum . . . *in:* Acta Societatis Scientiarum Fennicæ, Tom. XV, p. 728.

1891. *N. lutea* Müller; Duda, Klub. prirod. Praze, p. 13, pl. iv, fig. 1. (Kirkaldy).

1897. *N. lutea* Müller; Kirkaldy, Trans. Ento. Soc. London, 1897, p. 425.

1905. *N. lutea* Müller; Hueber, Jahresh. Ver. Vaterl. Naturk. Württemberg, lxi, p. 118.

1909. *N. lutea* Müller; Oshanin, Verz. Palæ. Hem., I, p. 976.

1909. *N. lutea* Müller; Kuhlgatz, Süsswasserf. Deutschl. (Brauer) VII, p. 82.

1912. *N. lutea* Müller; Jensen-Harrup, Danmarks Fauna, xii (Tæger), p. 31.

1912. *N. lutea* Müller; Oshanin, Katalog der Paläarktischen Hemipteren, p. 91.

1916. *N. lutea* Müller; Lundblad. Ento. Tidsk., p. 220.

1922. *N. lutea* Müller; Lundblad. Ento. Tidsk., p. 73.

1923. *N. lutea* Müller; Bueno & Hussey, Bull. Brooklyn Ento. Soc., xviii, p. 106.

1924. *N. lutea* Müller; Hale, Proc. Lin. Soc. New South Wales, vol. xlix, pt. 4, p. 462. (Notes concerning.)

1925. *N. lutea* Müller; Schmidt, Jahrb. des Nassauischen Veriens für Naturkunde, Jahrgang 77, p. 78 ("neu für die Rheinprovinz").

1928. *N. lutea* Müller; Hutchinson, Ento. Mo. Mag., lxiv, p. 35, 36. (Figs. genital capsule).

1929. *N. lutea* Müller; Hutchinson, Annals of South African Museum, xxv, pt. 3, p. 363.

Referring to this species, also:

1835. *N. unicolor* Herrich-Schäffer, Nomencl. Ento., 1, p. 63.

1845. *N. unicolor* Herrich-Schäffer, Wanz. Ins., viii, p. 23.

1851. *N. tumida* Germar Ms., Fieber mentions in his Rhynchotographieen, p. 473.

Size. Length, 14-16 mm.; width of pronotum, 4.8-5 mm.

Shape. Fairly plump-bodied insects.

Color. Typical color is luteous with brown ventor and legs of intermediate color. The costal margin of hemelytra often brown. Rarely there may occur melanistic specimens having black scutellum and dark hemelytra.

Structural Characteristics. Anterior outline of head, viewed from above, flattened; vertex shorter than its anterior width; anterior margin of vertex less convex than the margin of an eye; anterior breadth of vertex : synthlipsis : : 2.2 ± : 1. Pronotum at least twice as long as the head as seen from above; lateral margins of pronotum concave and only moderately divergent; anterior angles slightly produced, blunt; lateral ledge as seen from the side nearly straight, but slightly oblique, and subequal in length to the rear margin of the eye below it. Scutellum subequal in length to the pronotum. Ridge of hemelytral suture longer than scutellum. Anterior lobe of membrane longer than posterior one. Anterior trochanter of male with hook; mesotrachanter rounded, middle femur with a long stout anteapical tooth. Terminal abdominal sternite of female broad, somewhat constricted before the tip, which is blunt. First pair of gonapophyses in the female stout, broad and moderately long. The male genital capsule with short digitate process and clasper as shown on Plate XVII, fig. 2.

Location of Type. Kirkaldy reports that the type has been lost. The species, however, is well known.

Comparative Notes. This large pale species has its counterpart in *N. borealis* Bueno and Hussey of Northern North America which, for a long time, was confused with the European species and led to the erroneous record of "Nearctic" in Oshanin's catalogue. It is, however, structurally different from the American species, as shown by a study of the genitalia of both sexes. It is also specifically different from the species named *N. lutea* var. *scutellaris* by Reuter (see Plate XVII, figures 1 and 2.

Data on Distribution. This is a northern species. Reported by Oshanin in his catalogue as present in middle and northern Europe, Crimea and Siberia. Schmidt has reported it from the Rhine province, and I have specimens taken by Dr. O. Lundblad in Sweden; by H. Lindberg, in Finland; and others from Bohemia and Kossau. Doctor Poisson has kindly written me that this species is found in the northern part of eastern and central Europe, its western limits passing from Hanover southward through Alsace, the Jura and the Alps. He reports finding this species at one place, however, farther west (Lác d'Estivadoux near Besse in the department Puy-de-Dôme, France). From the map before me this appears to be in the Auvergne mountain district. Since the specimens from this place in France are structurally like *N. reuteri* Hungerford instead of like what I believe to be *N. lutea Müller,* the distributional records of these two species must be reviewed by the reëxamination of all available material.

Biological Notes. Delcourt,[22] 1909, gives considerable information about the distribution of this species and reports upon catches he has made. In collecting at Ulm, on August 25, 1907, he discovered that this species was fully developed sexually, while *N. glauca* L. was plainly of the new generation. Wesenberg-Lund,[84] 1915, reports that *N. lutea* Müller inserts its eggs into the tissues of plants and winters in the egg stage, its young hatching in the spring along with those of *N. glauca* L. While the egg stage of the latter lasts from four to six weeks, that of *N. lutea* Müller from eight to nine months.

Notonecta lutea Müller var. *schumacheri,* Schirmer, 1911

1911. *N. lutea* Müller var. *schumacheri,* Schirmer, Deutsch. Ento. Zeit., p. 680.

1912. *N. lutea* Müller var. *schumacheri,* Schirmer; Oshanin, Katalog der paläarkt. Hem., p. 91.

1928. *N. lutea* var. *schumacheri,* Schirmer; Esaki, Annals and Mag. Nat. Hist. (10), 11, p. 71.

Mr. Schumacher describes this variety as follows:

"Var. *schumacheri* Schirmer nov. In Grösse und Form der Stammart gleich, aber ganz Schwarz, nur der Kopf, das Pronotum und ein schmaler Flügelseitenrand gelb. Diese aufällige Varietät erlaube ich mir dem äusserst strebsamen jungen Forscher auf dem stiefmütterlich behandelten Gebiete der Rhynchoten, Herren F. Schumacher, zu widmen. In 2 Ex. wurde diese Varietät von mir mit der Stammform zusammen gefangen."

I do not agree that this should receive a varietal name. It is, no doubt, nothing more than an example of melanchroism in *N. lutea* Müller, such as I described in *N. borealis* Bueno and Hussey (1928).

Notonecta reuteri Hungerford 1928

(Color Plate IV, fig. 9; Plate XVII, fig. 1.)

1928. *N. lutea* Müller var. *reuteri* Hungerford, Bull. Brooklyn Ento. Soc., xxiii, June, 1928, No. 3, p. 128. (New name for *N. lutea* var. *scutellaris* Reuter, 1886, which was preoccupied by *N. variabilis* var. *scutellaris* Fieber 1851.)

Referring to this species, also:

1886. *N. lutea* Müller var. *scutellaris* Reuter, Medd. Soc. Faun. Flor. Fenn., xiii, p. 234.

1897. *N. lutea* Müller var. *scutellaris* Kirkaldy, Trans. Ento Soc. London, 1897, p. 425 (credits variety name to "Sahlb. S.").

1899. *N. lutea* Müller var. *scutellaris* Puton, Revue D'Entomologie, Tome xviii, p. 80 (credits var. name to "Sahlb. S.").

1904. *N. lutea* Müller var. *scutellaris* Kirkaldy, Wien. Ento. Zeit., xxiii, p. 132 (credits var. name to "Sahlb. S.").

1909. *N. lutea* Müller var. *scutellaris* Reuter; Oshanin, Verz. Palæ. Hem. 1, p. 976.

1912. *N. lutea* Müller var. *scutellaris* Reuter; Oshanin, Catalog. der Paläarkt. Hem., p. 91.

1927. *N. lutea* Müller var. *scutellaris* Reuter; Esaki, Ann. & Mag. Nat. Hist. (9), xx, p. 286 (Footnote).

1928. *N. lutea* Müller var. *scutellaris* Reuter; Esaki, Ann. & Mag. Nat. Hist. (10), vol. II, p. 70.

1933. *N. lutea* Poisson, Annales de la Soc. Ento. de France, Janvier, 1933.

1933. *N. lutea* Poisson, Bull. de la Soc. Scien. de Bretagne, X, Fasc. III et IV (Reprint, p. 1).

Size. Length, 14-15 mm.;* width of pronotum, 4.8 mm.

Shape. Slightly more slender and less elevated on the back than *N. lutea* Müller.

Color. Typical color is luteous with a dark median spot on the anterior portion of scutellum and a brown band along costal area of hemelytra, which is broader in rear than in front.

Structural Characteristics. Anterior outline of head, viewed from above, flattened; vertex a little shorter than its anterior width; anterior margin of vertex less convex than the margin of an eye; anterior margin of vertex : synthlipsis : : 2 : 1. Pronotum usually less than twice as long as the head as seen from above; lateral margins of pronotum concave and only moderately divergent; anterior angles more sharply produced than in *N. lutea* Müller; lateral ledge as seen from the side nearly straight, but slightly oblique and a little longer than the rear margin of the eye below it. Scutellum subequal in length to pronotum. Ridge of hemelytral suture longer than scutellum. (Anterior lobe of membrane longer than posterior one.) Anterior trochanter of male with a hook; mesotrochanter rounded. Middle femur with a stout anteapical tooth. Terminal abdominal sternite of female broad, more strongly constricted before the tip than in *N. lutea* Müller. First pair of gonapophyses in the female strong and moderately long. Male genital capsule with short digitate process and clasper as shown on Plate XVII, fig. 1.

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* The specimens so kindly sent to me from France by Doctor Poisson are only slightly more than 12 mm. long and have the scutellum pale. See my comments under *N. lutea* Müller.

Location of Type. Kirkaldy referred to *N. lutea* var. *scutellaris* J. Sahlb. and said it was exhibited to the Societas Fennica and a specimen given to him. I have this specimen before me. Doctor Kirkaldy was in error in assigning this species to J. Sahlberg, since Doctor Reuter had named it in 1886. The type ought, therefore, to be in Helsingfors, Finland. Since the name *N. scutellaris* was used by Fieber, 1851, for a Notonecta from South America, a change in name was necessary and, therefore, in 1928, *N. reuteri* was proposed.

Comparative Notes. This will be seen to be a species distinct from *N. lutea* Müller. Aside from a difference in the typical coloring, the shape of this species is more slender, the head and thorax are longer, and the male genitalia are different, as shown on Plate XVII, figures 1 and 2.

Data on Distribution. The J. Sahlberg specimen before me is from "Jaakima vii-20-1881." It is this specimen that is figured in Color Plate IV. Other specimens are recorded from Finland, Tammati; Jaakima, Finland (on the northwest shore of lake Ladoga and almost directly north of Petrograd). Doctor Kiritshenko has kindly given me specimens labeled "Lake Tsheznoje, near the rise of the river Oredezh, distr. Luga, Petrograd." Doctor Poisson writes me that the distribution of this species as he knows it is Finland, northern Russia and eastern Siberia.

There are in the British Museum three large, pale specimens, labeled by Kiritshenko *N. lutea* var. *scutellaris*, coming from "Amur" An examination of a male shows them to be smaller and paler than *N. amplifica,* but the male possesses a genital capsule and claspers like *N. amplifica* Kirit. 1930.

Notonecta viridis viridis Delcourt 1909

(Color Plate V, fig. 14; Plate XVII, fig. 12)

1909. *N. viridis* Delcourt, Bull, Sci. France de Belgique, xliii, p. 379; Tab. iv., lin. 2; Tab. v, lin. 18.

1924. *N. viridis* Poisson, Bull. Biol. Sci. France et Belique, lviii, Fasc. 1 (Life history and figures).

1925. *N. viridis* Poisson, Bull. Soc. Ento. France, 1925, p. 256. (Says *N. halophila* Edw. is a synonym.)

1928. *N. viridis* Hungerford, Annals Ento. Soc. Am., xxi, p. 143, pl. ix, fig. 1.

1928. *N. viridis* Esaki, Annals and Mag. Nat. Hist., ser. 10, vol. ii, pp. 68 and 74.

1933. *N. viridis viridis* Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.

1933. *N. viridis viridis* Delcourt; Poisson, Bull. de la Soc. Scien. de Bretagne, Tom. X, Fasc. III et IV. (Reprint, p. 1.)

Referring to this species, also:

1848. ? *N.* var. *pallida* Amyot, Ento. Franc. Rhynch., p. 337 (nom invalid, note by Esaki).
1897. *N. glauca* var. *glauca* Kirk., Trans. Ento. Soc. London, 1897, p. 421 (in part).
1918. *N. halophila* Edwards, Ento. Mon. Mag., liv, p. 58.
1923. *N. halophila* Butler, Biol. Brit. Hem. Heter., p. 559.
1930. *N. halophila* Jones, *in* Reprint from The Entomologists Record, vols. XL-XLII, p. 69.

Size. Length, 14.4 mm. to 15 mm.; width of pronotum, 4.5 mm. to 4.8 mm.

Color. General facies light. Head and limbs of usual color, often suffused with green. Scutellum black. Hemelytra when fully pigmented as shown in Color Plate V. Usually the hemelytra are less pigmented, the dark pigment confined to a row of spots along costal area and an X-shaped figure, the center of which is just behind the tip of the clavus.

Structural Characteristics. Head not prominent. Anterior outline of head very slightly convex; vertex shorter than anterior width; margin of vertex less convex than margin of the eye; anterior breadth of vertex : synthlipsis : : 2 + : 1. Pronotum more than twice as long as the head; lateral margins only slightly divergent and plainly concave near the anterior end; anterior angles acutely produced and strongly embracing the eyes; lateral ledge distinctly sigmoid, nearly horizontal and a little longer than the rear margin of the eye below it; other characters like subspecies below.

Location of Type. In Delcourt's collection. I am very unhappy to differ with Doctor Esaki concerning this nomenclatorial problem. He gives some quite convincing arguments why this species should be called *N. marmorea viridis* Delc. and the next one *N. marmorea marmorea* Fabr.

At the time I labeled my colored plates I was inclined to accept Doctor Esaki's conclusions. After further reflection, however, I am forced to reject my former stand in the matter. Fabricius described *N. maculata* in 1794. This species he described from specimens taken near Paris and is a readily recognized species with "abdomen atrum, fascia baseos apiceque fulvis." Although he wrote "Scutellum album," it is generally conceded that this was a typographical error for "Scutellum atrum." The identity of this species is not disputed. Then, in 1803, he described specimens from Algeria as *N. marmorea* as follows: "*N. glauca* elytris testaceis fusco maculatis. Habitat in Algier. Dom. Stubb. Mus. Dom. de Sestestedt. Statura omnino *N. glaucae.* Caput et thorax glauca, immaculata. Scutellum atrum. Elytra testacea, fusco maculata. Corpus nigrum pedibus glaucis."

When he says "Corpus atrum pedibus glaucis" his attention may have been focused upon the underside of the entire body. To consider "Corpus atrum" as meaning the abdominal dorsum would not be true for *N. viridis* Delc. any more than for *N. maculata* Fabr., because Delcourt's species has the distal part of the abdomen pale above.

I agree that the remainder of the description seems to fit *N. viridis* Delc. However, there are no specimens of *N. viridis* coming down from Fabricius' time, and there are two specimens in the Museum at Copenhagen that are now labeled types and which were named by Fabricius. One is a male labeled "Mus. Seh. & T. Lund" and "*N. marmorea* ex. Algier Stub." The other is a female labeled "Mus. Seh. & T. Lund." The male now has the hemelytra open just enough to show the yellow base of the abdominal dorsum.

Delcourt, 1909 (p. 377), noted this, for he wrote "Les caractéres tout à fait particuliers de coloration jaune d'une partie des tergites et tout l'ensemble ne permettent pas d'en douter." He, too, had seen these types and declared them to be *N. maculata* Fabr. Esaki, 1928 (p. 72), writes: "Thus Delcourt synonymized *marmorea* with *maculata,* but he does not actually mention whether or not he examined the dorsal surface of the Fabrician specimens, and he was ignorant of the pronotal differences between *viridis* and *maculata.* I am of the opinion that the type specimens of authors writing at the time, when the conception of the type specimen was not yet established, cannot be accepted as the standard for the species, unless they well agree with the description of the author, because, in those days, so many specimens were not, or insufficiently, labeled that there were a great many possibilities of confusion. . ." I must report that in these two specimens the anterior lateral angles of the pronotum are not produced as in *N. viridis* Delc. The specimens are the same as *N. maculata* Fabr. I believe them to be the types of *N. marmorea* Fabr. and in spite of the description should be recognized as such. While Doctor Esaki's arguments would be acceptable if no historical specimens were at hand, it would be unwise to ignore the specimens in Copenhagen and apply the name to some other species which also fails to meet the requirements of the description in some particular.

Comparative Notes. Distinguished from other European species at once by the acutely produced anterior angles of pronotum which embrace the eyes (except *N. reuteri* Hungerford).

Data on Distribution. For the most part at least this form inhabits brackish water, although Delcourt took it in fresh water near Paris and Poisson records it from Cæn and Rennes. Doctor Poisson writes me that the distribution as known includes England, the west and northwest coast of France and the fresh-water records in France as given above. My own specimens are from England.

Biological Notes. Doctor Delcourt in establishing this species based his conclusions regarding its specific distinctness more upon biological than structural evidence. He studied its natural habitat, its refusal to mate with *N. glauca* Linn., its less early development, its relative resistance to environmental adversity, and noted that its eggs and nymphs are smaller than those of *N. glauca* Linn. It remained for Edwards to point out a structural detail useful in determining this species. He pointed out the acute anterolateral angles of the pronotum of his *N. halophila*, which is now recognized to be *N. viridis* Delcourt. Like most other European species, this one deposits its eggs in the tissues of plants and winters as an adult insect.

Notonecta viridis mediterranea Hutchinson 1928

(Color Plate IV, fig. 5.)

1928. *N. viridis mediterranea* Hutchinson, Ento. Mo. Mag., lxiv, p. 35 (new name for *N. viridis meridionalis* Hutch.).

1933. *N. viridis mediterranea* Hutchinson; Poisson, Annales de la Soc. Ento. de France. Janvier, 1933.

1933. *N. viridis mediterranea* Hutchinson; Poisson, Bull. de la Soc. Scien. de Bretagne X. (reprint, p. 2).

Referring to this species, also:

1835. *N. glauca* var. *β* Burmeister, Handb. Ent. II, p. 190.

1840. ?. *N. marmorata* Spinola *fide* Fabr. Essai Ins. Hem., p. 59.

1840. *N. glauca* var. *maculata* Blanchard, Hist. Nat. Ins., iii, p. 89.

1843. *N. glauca* var. *marmorea* Amyot and Serville, Hem., p. 453.

1848. *N.* var. *marmorea* Amyot, Ento. Franc. Rhynch, p. 337 (Esaki says "nom. invalid").

1851. *N. fabricii* var. *marmorea* Fieber, Abh. Böhm. Gesel. Wis. (5), vii, p. 474.

1861. *N. fabricii* var. *marmorea* Fieber, Eur. Hem., p. 101.

1868. *N. glauca* var. *marmorea* Stal, Svensk. Vet. Akad, Handl., vii, No. 11 (Hem. Fabr.), p. 136.

1880. *N. glauca* var. *marmorea* Puton, Synop. Hém. Hétér. France, iii, p. 217.

1881. *N. glauca* var. *marmorea* Fabr., Puton, Synopsis, Hém. Hétér. France *in*: Memoires de la Société des Sciences de l'Agriculture et des Arts, 4° Série, Tom. ix, p. 121.

1888. *N. glauca* var. *marmorea* Reuter; Rev. Syn. Hétér. Palæarcticorum *in*: Acta Soc. Scient. Fennicæ, Tom. xv, p. 726.

1897. *N. glauca* var. *marmorea* Kirk., Rev. d'Ento., xvi, pp. 223, 224.

1897. *N. glauca* var. *marmorea* Kirk., Trans. Ento., Soc. London, 1897, p. 421.

1906. *N. glauca* var. *marmorea* Distant, Faun. Brit. Ind. Rhynch, iii, p. 42.

1907. *N. marmorea* Fabr.; Delcourt, Comptes Rendus des Séances et Mem. de la Soc. de Fr. Biologie, vol. 62, pp. 11-13.

1909. *N. viridis* Delcourt, Bull. Soc. France et Belgique, xliii, p. 379 (in part).

1909. *N. glauca* var. *marmorea* Oshanin, Verz. Palæ. Hem., I, p. 975.

1915. *N. glauca* var. *marmorea* Bollweg, Verh. des Naturhist. Vereins der Preussischen Rheinland und Westfalens 71, Jahrg. 1914, Mai, 1915, p. 174.

1922. *N. glauca* var. *marmorea* Despax, Bull. Soc. Hist. Nat. Toulouse, 1922, pp. 97-112.

1924. *N. marmorea* Poisson, Bull. Biol. de la France et de la Belg. T. lviii, Fasc. 1, p. 110.

1925. *N. viridis* Poisson, Bull, Soc. Ento. France, p. 328, fig. 1.

1927. *N. viridis meridionalis* Hutchinson, Ann. and Mag. Nat. Hist. (9), xx. p. 375 (description given, name later changed.).

1928. *N. marmorea marmorea* Esaki, Annals and Mag. Nat. Hist., ser. 10, vol. ii, p. 67.

1928. *N. viridis meridionalis* Poisson, Bull. Soc. Ento. France, No. 6, p. 107.

1929. *N. marmorea mormorea* Hutchinson, Annals of South African Mus., vol. xxv, pt. 3, p. 363.

Size. Length, 13.2 mm. to 14.4 mm.; width of pronotum, 4.2 mm. to 5 mm.

Color. Some specimens are colored as in the illustration on Color Plate IV, others show the rear half of pronotum dark, due to the black mesonotum beneath, and have the lighter markings of the hemelytra tan to pale orange. Scutellum black. The costal area of the hemelytra nearly always checkered with a row of roughly rectangular spots. Venter black except connexivum and tip of abdomen.

Structural Characteristics. Head not prominent. Anterior outline of head moderately convex; vertex shorter than anterior width; margin of vertex less convex than margin of the eye; margin of vertex longer than frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 2 + : 1. Pronotum more than twice as long as the head; lateral margins only moderately divergent and slightly concave; anterior angles acutely produced and embracing the eyes; lateral ledge, as seen from the side, distinctly sigmoid, nearly horizontal and a little longer than rear margin of the eye below it. Scutellum longer than the pronotum. Anterior lobe of membrane longer than the posterior. Anterior trochanter of male with slight obscure elevation. Mesotrochanter rounded. Terminal abdominal sternite of female large, constricted near the tip, which is bluntly pointed. First pair of gonapophyses moderately long.

Location of Type. Now in British Museum. Type labeled "Astroni near Naples, Italy, 19, IV, 1926."

Data on Distribution. I consider the species to include 3 subspecies, one of which is *N. viridis mediterranea* Hutch., and have seen specimens labeled as follows: "Egypte, Bir-Hooker, J. Dewitz, 1904;" "Milano, Italy; Tyrolia, J. Sahlb;" "Bethlehem, J. Sahlb;" "Kotschy, Ost Medit." (Vienna Mus.); "Baluchistan, Kushdil, Khan Pishin, India"; "Plateau Persan occid. De Hamadan a Zendjan J. de Morgan, 1904 (Paris Mus.)." Doctor Poisson has kindly supplied me with the following distributional notes: "Southern France, Spain, North Africa, Italy, Sardinia, Sicily, Corsica, Hungary, Greece, Cyprus, Macedonia, Asia-minor, Palestine, Crimea, Transcaspia, Persia, Turkestan. About the Mediterranian, but showing a tendency toward a vast dispersion east and southeastward." My own observations extend this eastward distribution to India, and Hutchinson lists Daulatabad, Seistan.

Notonecta viridis kashmiriana new subsp.

(Color Plate V, fig. 13; Plate XVII, fig. 5)

Size. A little smaller than the others.

Color. Typical color as shown on Color Plate V.

Structural Characteristics. Closely related to *N. viridis mediterranea* Hutch. The synthlipsis relatively a trifle wider, the lateral margins of the prothorax more divergent and the genital claspers of the male as figured on Plate XVII, fig. 5.

Location of Types. Holotype and allotype in Indian Museum, Calcutta; paratypes in Francis Huntington Snow Entomological Museum, University of Kansas. Described from five specimens labeled: "Kashmir Survey, Pond on roadside near Missionary Hospital, Sprinagar, Kashmir, N. W. Himalayas, Sta. 3, 10, VI, 21."

Discussion. There is before me also a series labeled: "Daulatabad, Seistan 20. XII, 18. Sta. 29, B. S. Village Pond." In these the male genital clasper is not quite like the above, but intermediate between it and *N. viridis mediterranea* Hutch. These groups appear to involve the same problem encountered with *N. unifasciata* Guérin in America.

NOTONECTA OF WESTERN HEMISPHERE

KEY TO NOTONECTA OF NORTH, CENTRAL, AND INSULAR AMERICA[†]

1. Keel of fourth abdominal sternite bare, the hairs confined to the sides. (See Plate X, figs. 1 and 2).. (2)

   Keel of fourth sternite not bare (except in *N. borealis*). (See Plate X, figs. 3 and 4, (14)

2. Head broad; eyes large and broad, rear width usually greater than length of the lateral margin of pronotum; scutellum conspicuously broader than long; last abdominal sternite of female narrow, side margins usually concave. (See Plate X, fig. 1).. (3)

   Head not conspicuously broad and short. Eyes not transverse, rear width not as great as length of lateral margin of pronotum. Scutellum not conspicuously broader than long. The last abdominal sternite of female not narrow with concave side margins. (See Plate X, figs. 2 and 3).............................. (12)

3. Lateral margins of pronotum of males straight[*] and nearly so in female. Penultimate abdominal sternite of female slender at tip.................................. (4)

   Lateral margins of pronotum of males at least slightly concave, females plainly so. Penultimate abdominal sternite of female fairly broad, explanate near caudal end or, if slender, plainly running to this section by the concave lateral margins of pronotum .... (6)

[†] Read Section III beginning p. 12.

[*] Males of *N. ceres stirtoni* have lateral margins of pronotum almost straight, but the females have the margins plainly concave.

4. Length not more than 12 mm. Last abdominal sternite of male not unusually broad. Penultimate abdominal sternite, of female, pointed at tip. Last sternite slender. (See text figure 3)................................*N. hoffmanni.*
(California, Arizona and Lower California, p. 68.)

Length more than 12 mm. Last abdominal sternite of male unusually broad. Penultimate abdominal sternite of female not pointed, but more or less incised at tip and last sternite rather broad. (Plate X, fig. 1).................... (5)

5. Genital capsule of male with large lobe in front of clasper. Penultimate abdominal sternite of female plainly notched at tip..........................*N. lobata.*
(New Mexico, Texas, Mexico, p. 70.)

Genital capsule without large lobe in front of clasper. Penultimate abdominal sternite of female faintly notched at tip..........................*N. hintoni.*
(Mexico, p. 72.)

6. Anterolateral angles of pronotum acute and snugly embracing the eyes. (Plate XVII, fig. 4).. (7)

Anterolateral angles of pronotum not as above (See Plate VIII, fig. 8)........... (9)

7. Lateral margins of pronotum abruptly constricted, greatly so in female. Last abdominal sternite of female broad. (Text figure 5)............*N. compacta.*
(Mexico, p. 73.)

Lateral margins of pronotum concave, not abruptly constricted. Last abdominal sternite of female narrow. (Text figure 5)................................ (8)

8. Length more than 12 mm..................................*N. mexicana.*
(Mexico, p. 75.)

Length 12 mm. or less......................................*N. m. creaseri.*
(Mexico, p. 77.)

9. Large and robust. Male clasper without sharp basal projection. Females with lateral margins of pronotum constricted just behind the anterolateral angles, which flare outward...*N. robusta.*
(Mexico, p. 78.)

Size moderate to small for this subgenus. Male clasper with a sharp basal projection. Females not as above.. (10)

10. Lateral margins of pronotum of male almost straight. Penultimate abdominal sternite of female fairly broad and expanded before the tip. (Text figure 6)
N. ceres stirtoni.
(Mexico, p. 80.)

Lateral margins of pronotum of male plainly concave. Penultimate abdominal sternite of female narrow and slightly expanded before the tip. (Text figure 6), (11)

11. Length 12 mm. or less. The lateral margins of the pronotum of female constricted near the middle..*N. ceres ceres.*
(Costa Rica, p. 79.)

Length more than 12 mm. The lateral margins of the pronotum of female constricted in front of the middle................................*N. c. rogersi.*
(Costa Rica, p. 81.)

12. Keel of fourth and fifth abdominal sternites bare, the hairs confined to the sides ....*N. impressa and N. montezuma.*
(Mexico and Texas, pp. 81 and 82.)

Keel of fourth abdominal sternite only bare, the hairs confined to its sides......... (13)

13. Synthlipsis usually less than one-half width of eye. Metaxyphus typically yellow. Head one-half as long as pronotum............................*N. insulata.*
(Eastern Canada and Northern United States east of 100th meridian, p. 84.)

Synthlipsis usually fully one-half to two-thirds width of eye. Metaxyphus typically black. Head less than one-half as long as pronotum................*N. kirbyi.*
(Western Canada, Northern United States, west of 100th meridian and south to Texas, p. 88.)

14. Last abdominal sternite of female large but strongly constricted just before the tip. Male with digitate prolongation on genital capsule.......................... (15)

Last abdominal sternite of female not large nor strongly constricted just before the tip. Male without digitate prolongation on the genital capsule................ (16)

15. Color dark, scutellum black, hemelytra irrorated with brown and blue-black. Synthlipsis narrow, only one-third anterior margin of vertex viewed from above. ....*N. irrorata.*

(Eastern Canada and Eastern United States south to Gulf and west to Kansas, p. 92.)

Color light, scutellum pale, hemelytra pale.* Synthlipsis greater than one-third anterior margin of vertex.......................................*N. borealis.*
(Across Canada and in Michigan and Minnesota, U. S. A., p. 95.)

16. Pronotum broad in front, embracing the eyes, which are flattened and receding from the anterior margin of the vertex. Synthlipsis broad, one-half anterior margin of vertex as seen from above. Scutellum plainly broader than long. Males with stout tubercle at angle of front trochanter and a very stout, broad hook as shown on Plate IX, fig. 4...(17)

Pronotum not broad in front. Eyes not as above. Scutellum not plainly transverse. Males without stout tubercle at angle of front trochanter and with a small hook on its anterior surface...(21)

17. Length usually not more than 12 mm.......................................(18)

Length usually more than 12 mm.......................................(19)

18. Pronotum steeply declivant as viewed from the side. Dark form with hemelytra brown to nearly black without luteous stripes. Luteous form with tinge of orange. Male genital capsule as on Plate XIII..................*N. melaena.*
(Mexico, p. 97.)

Pronotum not steeply declivant. Dark form unknown to me. Luteous form pale luteous. Male genital capsule with a thickened protuberance on keel...
N. ochrothoe.
(Southern California to Colombia, S. A., p. 99.)

19. Anterior end of lateral ledge of pronotum broadly flattened, the ledge plainly wider beneath than the diameter of the second antennal segment. Penultimate abdominal sternite of female broadly triangular. (Text figure 7).....*N. repanda.*
(Arizona to Mexico, p. 100.)

Anterior end of lateral ledge of pronotum not broadly flattened, scarcely, if any, wider than the diameter of the second antennal segment. Penultimate abdominal sternite of female slenderly triangular. (Text figure 7)....................(20)

20. Caudal half of lateral margin of pronotum plainly undulate as seen from side. Vertex of female not as below. Male genital capsule as on Plate XIII, fig. 8.
N. shooteri.
(California, p. 101.)

Caudal half of lateral margin of pronotum of male nearly straight. Anterior margin of vertex of female considerably produced beyond the very receding eyes. ....*N. colombiana.*
(Colombia, S. A., p. 128.)

21. Mesotrochanter plainly angulate or produced into a tooth or stout spinelike process, (22)

Mesotrochanter rounded or nearly so.......................................(26)

22. Synthlipsis very narrow, not more than one-sixth the anterior margin of the vertex as seen from above. Hemelytra brick red to orange with black blotch on corium ....*N. uhleri.*
(Eastern United States from Massachusetts to Florida westward to Mississippi river, p. 103.)

Synthlipsis usually broader than above. Hemelytra not red or orange............(23)

23. Scutellum typically pale.......................................(24)

Scutellum typically black with flavous lateral margins..........................(25)

24. Synthlipsis about one-fourth width of eye..........................*N. raleighi.*
(Southeastern United States, p. 105.)

Synthlipsis about one-third width of eye..........................*N. lunata.*
(Eastern Canada and northern states west to Wisconsin, p. 107.)

25. Synthlipsis at least one-half anterior margin of vertex. Mesotrochanter not produced into a long spinose process................*N. unifasciata* and subspecies.
(Mexico north to western Canada, pp. 109 to 111.)

Synthlipsis less than one-half anterior margin of vertex. Mesotrochanter produced into a long spinose process..................................*N. spinosa.*
(Western Canada and northwestern U. S. A., p. 112.)

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* Often there is a dark submarginal streak, and rarely the scutellum is black and the hemelytra marked nearly as in *N. irrorata* Uhler.

26. Synthlipsis distinctly less than one-half anterior margin of vertex, head prominent, hemelytra usually black and white.. (27)
Synthlipsis nearly one-half anterior margin of vertex. Head not prominent. Pale or marked with black.. (28)

27. Anterior margin of vertex (seen from above) straight and width less than length of vertex. Male clasper broad, shallowly incised at tip. Last abdominal sternite of female with apical notch broader than deep if present. Typical color with broad black band across distal end of hemelytra....................*N. indica.*
(North America south of 37° latitude, Insular America, S. A., p. 113.)
Anterior margin of vertex rounded and width subequal to length of vertex. Male clasper deeply incised. Last abdominal sternite of female with apical notch deeper than broad. Typical color with narrow undulate band across hemelytra ....*N. undulata.*
(Across Canada, widespread in United States to Mexico, p. 117.)

28. Male clasper bifurcate.. (29)
Male clasper not bifurcate. (Plate XIV, fig. 8)....................*N. indicoidea.*
(Mexico, p. 123.)

29. Clasper broad and deeply furcate. (Plate XIII, fig. 7)..............*N. confusa.*
(South America, p. 130.)
Clasper plump and shallowly notched. (Plate XIII, fig. 9).......*N. distinctoidea.*
(Mexico, p. 124.)

*Notonecta hoffmanni** Hungerford 1925

(Color Plate III, fig. 12; Plate XI, fig. 6; text figure 3.)

1925. *N. hoffmani* Hungerford, Can. Ento. lvii, p. 241, pl. vi, fig. 6.

Referring to this species also:

1894. *N. mexicana* Uhler, Proc. Calif. Acad. Sci. (2), iv, p. 292.
1897. *N. mexicana* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 402. (Bassee Californie, Diguet 1895, Paris Mus.)
1901. *N. mexicana* Champion, Biol. Centr. Amer. Hem.-Het. ii, p. 368.
1905. *N. mexicana* Bueno, Jl. N. Y. Ento. Soc. xiii, p. 158 (in part).
1907. *N. mexicana* Kirkaldy and Bueno, Proc. Ento. Soc. Wash. x, p. 198 (in part).
1914. *N. mexicana* Van Duzee, Trans. San Diego Soc. Nat. Hist. ii, p. 33.
1917. *N. mexicana* Van Duzee, Catalog of Hem. p. 454 (in part).
1919. *N. mexicana* Hungerford, Kans. Univ. Sci. Bull. xi, p. 170 (in part).

Size. Length, 10 mm. to 11.5 mm.; width of pronotum, 3.9 mm. to 4.5 mm.

Color. Orange red and black to horn and black. Head, pronotum and limbs yellow. Scutellum black. Membrane of hemelytra from dusky to brownish black. Trochanter and femur of middle and hind legs with the longitudinal dark stripe characteristic of the *N. mexicana* A. & S. group.

Structural Characteristics. Head large, anterior outline, as viewed from above, flattened; vertex a little longer than its anterior width; anterior margin of vertex less convex and plainly shorter than the frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 3:1, sometimes a little broader. Pronotum about one and eight-tenths the length of the head; lateral margins moderately divergent and nearly straight, somewhat explanate on anterior two-thirds, anterior lateral angles rounded; lateral ledge, as seen from the side, nearly straight. Anterior lobe of membrane of hemelytron larger and longer than the posterior one. Anterior trochanter of the male with a short, inconspicuous hook. Mesotrochanters rounded. Carina of fourth abdominal sternite bare; last abdominal sternite of female slender, boarder at tip than middle and incised at tip. First pair of gonapophyses short. Male genital capsule as shown on Plate XI.

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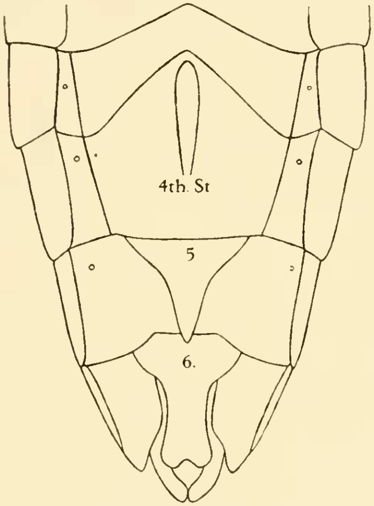
* Name in honor of W. E. Hoffmann and one "n" omitted in error.

Location of Types. In the Francis Huntington Snow Entomological Museum of the University of Kansas. Described from a series of insects taken at Laguna Beach,* California, C. T. Dodds. collector. Other paratypes from California and Lower California.



N. hoffmanni.

TEXT FIGURE 3. *N. hoffmanni* Hungerford, showing the venter of the abdomen of a female. Compare with text figures 5 and 6. (Subgenus Erythronecta.)

Comparative Notes. This species belongs to the *N. mexicana* A. & S. group and until 1925 was confused with *N. mexicana* A. & S. It is a trifle smaller than *N. ceres* Kirkaldy, from which it differs in having almost straight, not sinuate, lateral margins of the prothorax.

Data on Distribution:

CALIFORNIA. Laguna Beach, C. T. Dodds; Laguna Mts., July 6, 1929, L. D. Anderson; Alpine, July 9, 1929, R. H. Beamer; San Diego Co., July 4, 1929, L. D. Anderson; San Diego Co., August 5, 1913, E. P. Van Duzeé (Drake Coll.); San Diego Co., April 9, 1930, C. & D. Martin; Indio, July 24, 1929, L. D. Anderson; Claremont, C. F. Baker (Uhler Coll.); Monrovia Canyon, March 2, 1930, Mrs. C. H. Martin; Mission Creek, Santa Barbara, 1915, C. H. Kennedy; California, L. Lethierry (Det. by him as *N. mexicana*); Winters, August 6, 1929, R. H. Beamer.

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* Not Long Beach, as stated in original description.

ARIZONA. Huachuca Mts., 5,200 ft., May 20, 1919, R. D. Champ.; Salome Creek, Sierra Ancha Mts., Gila Co., September 1, 1932, D. K. Duncan; Chiricahua Mts., Pinerey Canyon, Hands Ranch, June 16, 1932, D. K. Duncan.

LOWER CALIFORNIA, MEXICO. El Paraiso, May, 1889, Chas. D. Haines. (Det. by Kirkaldy as *N. mexicana*). Santa Maria, May, 1889, Chas. D. Haines (Uhler Coll.).

Notonecta lobata Hungerford 1925

(Color Plate III, figs. 5, 10, 11, 13; Plates X, fig. 1, and XI, fig 2.)

1925. *N. lobata* Hungerford, Can. Ento. lvii, p. 239, Pl. vi, fig. 3.
1928. *N. lobata* Hungerford, Annals Ento. Soc. Amer. xxi, p. 142.
1931. *N. lobata* Bueno, Bull. Brooklyn Ento. Soc. xxvi, No. 3, p. 138.

Referring to this species, also:

1884. *N. mexicana* Uhler, Standard Nat. Hist. II, p. 252.
1897. *N. mexicana* Kirkaldy, Trans. Ento. Soc. London for 1897, pp. 401, 402 (in part).
1901. *N. mexicana* Champion, Biol. Centr. Amer. Hem.-Het. II, p. 368 (in part).
1905. *N. mexicana* Bueno, Jl. N. Y. Ento. Soc. xiii, p. 158 (in part).
1906. *N. mexicana* Snow, Trans. Kans. Acad. Sci. xx, pt. 1, p. 181.
1907. *N. mexicana* Snow, Trans. Kans. Acad. Sci. xx, pt. 2, p. 160.
1909. *N. mexicana* Kirkaldy and Bueno, Proc. Ento. Soc. Wash. x, p. 198.
1918. *N. mexicana* Hungerford, Ento. News xxix, p. 245, pt. xv, fig. 7.
1919. *N. mexicana* Hungerford, Kans. Univ. Sci. Bull. xi, p. 170 (in part).
1919. *N. mexicana* Hungerford, Kans. Univ. Sci. Bull. xi, pl. xxxii, fig. 4 (male genital capsule).

Size. Length, 13 mm. to 14 mm.; width of pronotum, 4.3 mm. to 5 mm.

Color. Typically red and black. Some specimens are brownish black with beige trimmings and others are greenish-tan. All have the head, pronotum and limbs yellow or gray and scutellum and membrane of hemelytron black. The hemelytra, excepting the membrane, are typically red. The males of the red forms frequently have the black of the membrane extending forward upon the distal portion of clavus and corium. The pale and dark forms have only the slightest suggestion of red. Middle and hind trochanters and femora with longitudinal median streaks of brown or black.

Structural Characteristics. Head large, anterior outline, as viewed from above, flattened; vertex slightly longer than its anterior width; anterior margin of vertex less convex and plainly shorter than the frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 19:7. Pronotum about one and two-thirds length of the head, lateral margins divergent, straight in male and nearly so in female. Anterior angles normal; lateral ledge as seen from the side sinuate and oblique and shorter than the rear margin of eye below it; anterior half moderately explanate. Anterior lobe of membrane larger than the posterior one. Anterior trochanter of the male with short inconspicuous hook. Mesotrochanters rounded. The keel of fourth abdominal sternite bare. Last abdominal sternite of female slender, not, or little, broader at tip than middle, tip incised. First pair of gonapophyses short. Last abdominal sternite of male unusually broad and rounded; male genital capsule with large lobe in front of clasper. (See Plate XI, fig. 2.)

Location of Types. In the Francis Huntington Snow Entomological Museum of the University of Kansas; seventeen specimens taken by P. A. Glick in the Superstition Mountains, Arizona.

Comparative Notes. This species belongs to the *N. mexicana* A. & S. group and, until 1925, was confused with *N. mexicana* A. & S. It is a common species in the southwest part of the United States.

Data on Distribution:

ARIZONA. Superstition Mts., November 11, 1922, P. A. Glick; Santa Rita Mts., Alt. 8,000 ft., June 19, F. H. Snow; Santa Rita Mts., July 25, 1927, and July 17, 1932, R. H. Beamer; Sabino Canyon, July 14, 1932, R. H. Beamer; Grand Canyon, 6 miles below North Haxasn Crk., September 16, 1923, R. C. Moore; Huachuca Mts., 5,750 ft., March 16, 1919, R. D. Camp (Univ. of Mich.); Baboquivari Mts., July 18, 1932, R. H. Beamer; Huachuca Mts., July 8, 1932, R. H. Beamer; Cochise Co., July 29, 1927, L. D. Anderson; Pima Co., July 27, 1927, R. H. Beamer; Gila Co., August 5, 1927, P. A. Readio; Yuvapai Co., August 9, 1927, L. D. Anderson; Chiricahua Mts., Pinerey Canyon, Hands Ranch, 5,000 ft., June 16, 1932, D. K. Duncan; S. Catalina Mts., Sabina Canyon, 3,000 ft., June 20, 1932, D. K. Duncan; Reservation Springs, 12 miles N. E. of Globe, September 17, 1932, D. K. Duncan. The following in U. S. N. M.: Ariz. (Uhler Coll.); Sabina Canyon, Hubbard Hot Springs, June 26, H. S. Barber; Bright Angel, Colo. Canyon 3,500 ft., H. S. Barber; Senator Mine, near Prescott, September 12, 1907, H. S. Barber; Catal, Spr. April 19, H. G. Barber; Huachuca Mts.; Santa Rita Mts., July 26, 1925.

NEW MEXICO. San Antonio, July 15, 1927, L. D. Anderson.

TEXAS. Valentine, July 13, 1927, L. D. Anderson; Presidio Co., July 15, R. H. Beamer. The following in U. S. N. M.: Kerrville, April 12, 1907, F. C. Pratt; Brewster Co., Chisos Mts., June 10-12, 1908, Mitchell and Cushman; Fort Davis, Jeff Davis Co., 5,000 ft., Davis Mts., Mrs. O. C. Poling (H. M. Harris).

MEXICO. Mex. (Uhler Coll.).

Biological Notes. On May 12, 1932, Mr. Douglas K. Duncan visited a small pool which is located twelve miles northeast from Globe, Arizona, on the Showlow road and two miles due east from the highway down a canyon. There is a small spring forming a small pool about six feet by six feet and from a few inches to eighteen inches deep; sandy and rock bottom; some moss, submerged twigs, etc. The elevation is about 4,000 feet. In this pool he took all the adults he could find, five of them, and noted many nymphs. On May 16th he again visited the pool and could find no adults, but took more than fifty nymphs for me, leaving about twenty others to mature. There were no other species of Notonecta in the pool.

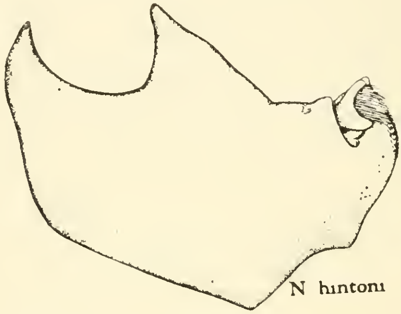
Notonecta hintoni new species

(Text figure 4)

1934. *N. hintoni* Hungerford, Jl. Kans. Ento. Soc. VII, No. 3, p. 97.

Size. Length, 14 mm. to 15 mm.; width of pronotum, 5.1 mm.

Color. Typically red and black. Some specimens may have the red replaced by tan. All have the head, pronotum and limbs yellow or gray and scutellum and membrane of hemelytron black. The hemelytra of females are typically red, excepting the membrane and a spot near the distal angle of the corium, which are black. The males are darker, having the red of the corium and clavus more or less suffused with black. Middle and hind trochanters and femora with longitudinal median streaks of brown or black.



TEXT FIGURE 4. *Notonecta hintoni* Hungerford, showing male genital capsule. Compare with drawings on Plate XI.

Structural Characteristics. Head large, anterior outline, as viewed from above, flattened; vertex of male slightly longer than its anterior width, subequal in female; anterior margin of vertex less convex and plainly shorter than the frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 19:7. Pronotum not more than one and two-thirds length of head; lateral margins divergent, straight to faintly concave; anterior angles about normal, slightly more produced than in *N. lobata* Hungerford; lateral ledge, as seen from the side sinuate and oblique and shorter than rear margin of eye below it; anterior half moderately explanate. Anterior lobe of membrane larger than the posterior one. Anterior trochanter of the male with an inconspicuous hook. Mesotrochanter rounded. The keel of the fourth abdominal sternite bare. Last abdominal sternite of female slender, sides not concave, tip incised. Last abdominal sternite of male unusually broad and rounded; male genital capsule as shown in figure 4. The clasper strikingly different from any other member of the subgenus Erythronecta.

Location of Types. Holotype, allotype and paratypes in the Francis Huntington Snow Entomological Museum. Paratypes will be sent to United States National Museum and to British Museum. Described from a series of twenty-nine specimens taken by Mr. H. E. Hinton in Real de Arriba, District of Temascaltepec. Altitude, 1,960 meters, Mexico.

Comparative Notes. General appearance that of *N. lobata* Hungerford. The males are distinguished from that species by the very different shape of the genital capsules and claspers. The females by having only an inconspicuous notch at tip of penultimate abdominal sternite. Lateral margins of last abdominal sternite of female not as curved as in *N. lobata* Hungerford.

Data on Distribution. Known only from the type locality.

Notonecta compacta Hungerford 1925

(Color Plate III, fig. 6; Plate XI, figs. 3 and 8; and text fig. 5)

1925. *N. compacta* Hungerford, Can. Ento., lvii, p. 239.

1933. *N. compacta* Hungerford, Bull. Brook. Ento. Soc., xxviii, p. 135 (allotype ♂).

Referring to this species, also:

1897. *N. mexicana* Kirkaldy, Trans. Ento. Soc. London (in part).

1901. *N. mexicana* Champion, Biol. Centr. Amer. Hem. Het. II, p. 369 (Amula in Guerreio).

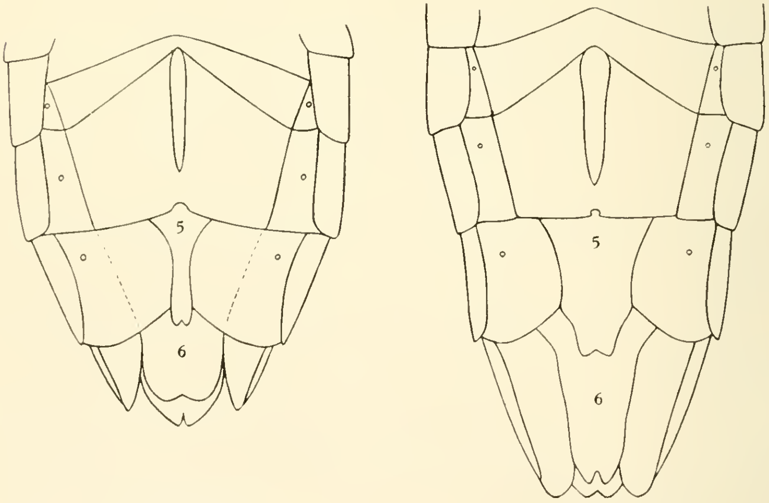
A dark male from Amula studied by Champion and another by Kirkaldy, labeled *N. mexicana* A. and S. by them. There is another specimen in Oxford Museum labeled by Kirkaldy.

Size. Length, 12.5 mm. to 14 mm.; width of pronotum, 4.8 mm. to 5.7 mm.

Shape. A comparatively short, plump-bodied species. The lateral margins of the prothorax in the female strongly constricted in the middle.

Color. Females are usually red and black and males nearly black. I have some females that are black like the males. Head, pronotum and limbs dark testaceous. Femora with dark longitudinal stripes beneath and the trochanters each with a dark elongate spot.

Structural Characteristics. Head large; anterior outline of head viewed from above, flattened; vertex slightly longer than its anterior width in the male, subequal in the female; anterior margin of vertex less convex and plainly shorter than the frontal margin of the eye; anterior breadth of vertex : synthlipsis : : 3 + :1. Pronotum about twice the length of the head in female. Head of male longer than half of the pronotum; lateral margins divergent, moderately constricted in the male but very strongly and characteristically constricted in the female. Anterior angles embracing the eyes. Lateral ledge unlike in the two sexes, sigmoid and oblique in both sexes as seen from the side; in the female the ledge is heavy and pronounced on the anterior half and almost obliterated and curved on the posterior half; in the male the anterior portion of the ledge is broader than elsewhere but not interrupted; anterior end of the ledge deflected in both sexes, margin of prothorax shorter than the rear margin of the eye below it. Scutellum a little longer than the pronotum. Posterior and anterior lobes of membrane subequal, the posterior sometimes a trifle longer. Anterior trochanters of the male with broad, blunt hook. Mesotrochanters not angulate. The carina or keel of the fourth abdominal sternite bare; this segment is short in the male and long in the female. In the male the penultimate abdominal sternite is enlarged. The terminal abdominal sternite of the female is as broad as long (exposed part) with lateral edges concave and tip incised. First pair of gonapophyses short. Male genital capsule as shown on Plate XI.



N compacta **N.m. mexicana**

Text Figure 5. *Notonecta compacta* Hungerford and *Notonecta m. mexicana* A. & S. Underside of abdomen of females. (Subgenus Erythroneeta.)

Location of Type. The type is in the U. S. N. M.

Comparative Notes. This species belongs to the *N. mexicana* A. and S. group. The last abdominal sternite of the female is more nearly quadrate than in the other species. No other species has the pronotum so conspicuously constricted laterally.

Data on Distribution. Colima, Mexico, coll. by L. Conradt; Amula, Guerrero, 6,000 ft., H. H. Smith; Between Cajones and Rincon, S. of Chilpancingo, Guerrero, Mex., July 1, 1932, Hobart Smith (18 specimens); Near Taxco, Guerrero, Mex., July 4, 1932, Hobart Smith (2 specimens). A male of the Hobart Smith collection is the allotype.

Notonecta mexicana mexicana Amyot and Serville, 1843

(Color Plate III, fig. 8; Plate XI, fig. 11; text figure 5.)

1843. *N. mexicana* Amyot & Serville, Hémiptères p. 453, Pl. viii, fig. 7.

1851. *N. mexicana* Amyot & Serville; Fieber, Rhynchotographieen, p. 475.

1851. *N. mexicana* Amyot & Serville; Fieber, Rhynchotographien, p. 51. (Van Duzee.)

1853. *N. mexicana* Herrich-Schaeffer, Wanzen. Ins. ix, p. 43, Tab. ccxciv, fig. 903 (in color).

1884. *N. mexicana* Uhler, Standard Nat. Hist., ii, p. 252 (in part).

1897. *N. mexicana* Amyot & Serville; Kirkaldy, Trans. Ento. Soc. London for 1897. p. 401 (in part).

1901. *N. mexicana* Amyot & Serville; Champion, Biol. Centr. Amer. Hem.-Het. ii, p. 368-369 (in part, but not figures). (Mexico, Sallé; Oaxaca, Sallé; San Luis Potosi, Palmer.)

1904. *N. mexicana* Amyot & Serville; Kirkaldy, Wien Ento. Zeit., xxiii, pp. 94 and 132 (in part).

1905. *N. mexicana* Amyot & Serville; Bueno, Jl. N. Y. Ento. Soc. xiii, pp. 145, 150, 158. (Ref. not localities.)

1909. *N. mexicana* Amyot & Serville; Kirkaldy & Bueno, Proc. Ento. Soc. Wash., x, p. 198 (in part).

1917. *N. mexicana* Amyot & Serville; Van Duzee, Catalogue Hemip., p. 454 (in part).

1919. *N. mexicana* Amyot & Serville; Hungerford, Kans. Univ. Sci. Bull. xi, (in part).

1925. *N. mexicana* Amyot & Serville; Hungerford, Can. Ento. lvii, p. 238.

1928. *N. mexicana* Amyot & Serville; Hungerford, Jl. Kans. Ento. Soc. v, p. 53.

Referring to this species, also:

1851. *N. klugii* Fieber, Rhynchotographieen p. 475 (in part).

1851. *N. klugii* Fieber, Rhynchotographien p. 51 (Van Duzee).

1925. *N. macrocephala* Hungerford, Can. Ento. lvii, p. 241, Pl. 6, fig. 5. (Syn. new.)

Size. Length, 13 mm. to 14 mm.; width of pronotum, 4.6 mm. to 5.1 mm.

Color. Typically a red and black species. The males a little darker than the females as a rule. Probably there exist black and tan females and black males, but I have never seen them. Anterior half of prothorax, head and limbs yellow, the middle and hind trochanters and femora with a median longitudinal dark stripe, front femur may have two such stripes on its rear margins, posterior half of pronotum may be darkened by the black mesonotum beneath. Scutellum black.* Clavus and corium orange red to red. Smoky or black areas may occur along hemelytral suture, beneath corial-claval suture, on the embolium, on outer half of corium and on membrane, which is nearly always dark.

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* Footnote: I have seen a specimen or two with yellowish scutellum that were otherwise fairly well colored.

Structural Characteristics. Head large, embraced at base by the anterior angles of prothorax. Anterior outline of the head, viewed from above, flattened; vertex subequal in length to its anterior width, sometimes in the male a little longer, anterior margin of vertex less convex and plainly shorter than the frontal margin of the eye; anterior breadth of vertex : synthlipsis : : 17:7. Pronotum not quite twice the length of the head, lateral margins moderately divergent, somewhat concave in the male, more so in the female. Anterior angles acute and embracing the eyes, more pronounced in the male than in the female. Lateral ledge moderately broad and horizontal on anterior half and oblique and nearly obliterated on posterior half; anterior angle slightly deflected in both sexes; margin of prothorax shorter than the rear margin of the eye beneath. Anterior lobe of membrane of hemelytra a little longer than the posterior. Anterior trochanters of male with a hook of moderate size, mesotrochanters rounded, the carina of the fourth abdominal sternite bare, the terminal abdominal sternite of female slender, elongate, but slightly constricted and the tip incised. First pair of gonapophyses rather slender. Male genital capsule as shown on Plate XI.

Location of Type. I have been unable to find the types in Paris or elsewhere.

Comparative Notes. The description I have given above applies to the species that fits best Amyot and Serville's brief description and the color drawing. The size (14 mm.), the parallel sides and the distribution point to this species. In former writings I have been confused by Kirkaldy and Champion and believed *N. mexicana* A. & S. to be something else. I now conclude that my *N. macrocephala* is only an unusual specimen of this species and, therefore, suppress it. I described it from a single specimen with an abnormally large head, but the genitalia are indistinguishable from the species described above. The slender, tapering last abdominal sternite of the female distinguishes this species.

Data on Distribution. Described from "Mexico," and unfortunately most of the specimens I have seen bear no more precise label. However, in the Museum at Vienna there is a specimen labeled "San Luis Potosi, Dr. Palmer." This was determined by Champion as *N. mexicana.* There is another specimen from Signoret's collection labeled "Bogota." There are two specimens from Mexico by Sallé in the museum at Stockholm.

Notonecta mexicana v. *creaseri* Hungerford 1932

(Color Plate II, fig. 13; Plate XI, figs. 1 and 9.)

1932. *N. mexicana* v. *creaseri*, Hungerford, Jl. Kans. Ent. Soc., v., p. 53.

Size. Length, 12 mm.; width of pronotum, 4.3 mm.

Color. The four specimens at hand are tan and black with one specimen showing some flecks of red on the corium. Head and legs testaceous. The femur with a longitudinal stripe which is characteristic of entire group. Scutellum is black or nearly so, three of the specimens with lateral margins tan. The clavus and corium mostly tan. The distal third of corium more or less dark. Membrane nearly black. It is probable that this variety, like other species in the group, may have red or nearly black in place of the tan on the hemelytra.

Structural Characteristics. Anterior outline of the head, viewed from above, flattened; vertex longer than its anterior width; margin of vertex less convex and shorter than frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 11:4 (in the female). In the male the synthlipsis is a little narrower. Pronotum about twice length of head; lateral margins short, divergent, but quite concave in the females and plainly so in the males; anterior angles embracing the eyes; lateral ledge as seen from the side with anterior three-fifths broad and nearly horizontal and posterior two-fifths faint and oblique; the anterior angle deflexed; the length of the ledge less than the rear margin of the eye below it. Anterior lobe of the membrane of the hemelytron distinctly longer than the posterior lobe. The anterior trochanter of the male with a rather narrow, pointed hook. Mesotrochanter rounded. The genitalia in both sexes like *N. mexicana* A. & S. (See Plate XI.)

Location of Types. Described from four specimens labeled, "Mexico, Nueva Leon, Santiago, April 19, 1930, 13. Creaser-Gordon." Holotype and allotype in Museum of Zoölogy, Michigan University. Paratype in Entomological Museum, University of Kansas.

Comparative Notes. This is smaller than the typical *N. mexicana* A. & M., but in the characters of the genitalia indistinguishable from it.

Notonecta robusta Hungerford 1932

(Color Plate II, fig. 14; Plate XI, figs. 4 and 10)

1932. *N. robusta* Hungerford. Jl. Kans, Ento. Soc., v, p. 54.

Size. Length (of male), a trifle less than 15 mm.; the width of pronotum, 5.1 mm.

Color. The holotype has the head, pronotum and limbs dark testaceous. The trochanters and femora marked as in other species of the *N. mexicana* A. & S. group. Scutellum black and hemelytra nearly black. No doubt this species may have hemelytra that are tan or red with black membrane.

Structural Characteristics. Anterior outline of the head, viewed from above, flattened; vertex about as long as the anterior width; margin of vertex less convex and shorter than the frontal margin of an eye; anterior breadth of vertex : synthlipsis :: 10.5:4. Pronotum about twice length of head; lateral margins divergent and nearly straight in the male; anterior angles not embracing the eyes; lateral ledge, as seen from the side, slightly undulate, upturned at both ends, oblique and shorter than the rear margin of the eye below it. Scutellum and ridge of hemelytral suture equal in length. Posterior lobe of membrane a little longer than anterior lobe. The anterior (outer) margin of the membrane constricted at the embolial suture and undulate. Anterior trochanter of male with short hook. Mesotrochanter rounded. Male genital capsule much like *N. mexicana* A. & S., but the clasper with the tip broader and the rear margin more concave. (See Plate XI, figs. 4 and 10.)

Location of Type. Described from a single male specimen which bears no locality or collector's label. Deposited in Entomological Museum, University of Kansas.

Comparative Notes. Agrees with other species of *N. mexicana* A. & S. group in having the keel of fourth ventral abdominal segment bare, the hairs confined to the sides. Head broad, eyes large and broad, rear margin broader than the length of the lateral margin of prothorax. Scutellum conspicuously broader than long. It differs from *N. lobata* Hungerford in having the last abdominal sternite of male normal in size. I have two female specimens, red and black in color, from San Cristobal, Chiapas, Mexico, A. Dampf., that are the broadest, most robust Notonecta known to me. The lateral margins of the pronotum are greatly constricted near the front so that the anterior angles flare out. The very marked undulation of the anterior (outer) margin of membrane suggests to me that these may be females of *N. robusta* Hungerford.

Notonecta ceres ceres Kirkaldy 1897

(Color Plate III, figs. 2 and 3; Plate XI, fig. 7; text figure 6)

1897. *N. mexicana* var. *ceres* Kirkaldy, Ento. Soc. London, p. 402, 1897.
1904. *N. mexicana* var. *ceres* Kirkaldy, Wiener Ento. Zeit., xxiii, p. 132.
1905. *N. mexican* var. *ceres* Kirkaldy; Bueno. Jl. N. Y. Ento. Soc., xiii, p. 159.
1917. *N. mexicana* var. *ceres* Kirkaldy; Van Duzee, catalogue of Hemiptera . . p. 454.
1925. *N. mexicana* var. *ceres* Kirkaldy; Hungerford, Can. Ento., lvii, p. 238. (Says are all females, the variety *hades* all males.)

Referring to this species, also:

1851. *N. klugii* Fieber, Rhynchotographieen, p. 475 (in part).
1897. *N. mexicana* var. *hades* Kirkaldy. Ento. Soc. London, p. 402, 1897. This is only the male of *N. ceres* Kirkaldy. See list of references above.
1901. *N. mexicana* Champion. Biol. Centr. Am. Hem.-Het., 11, p. 369, Tab. 22, figs. 6, 6a-d (in part).

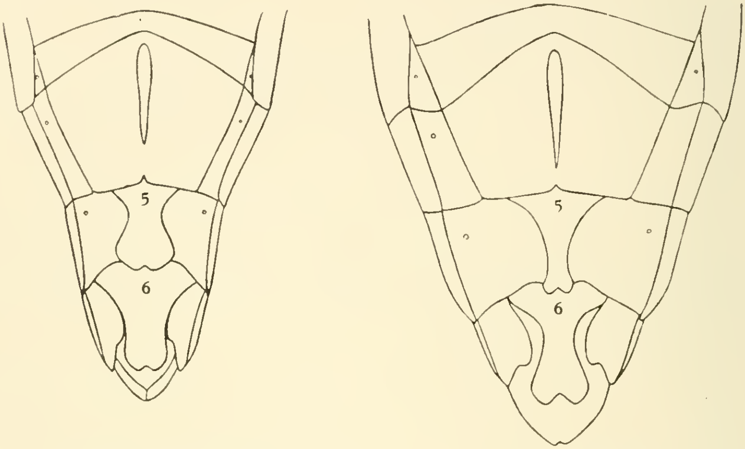
Size. Length, 11 mm. to 12 mm.; width of pronotum, 4.3 mm. to 4.8 mm.

Color. Red and black, tan and black, or, in case of males, black. Anterior half of pronotum, head and limbs yellow, the middle and hind trochanters and femora with the dark stripe usual for the *N. mexicana* A. & S. group.

Structural Characteristics. Head large; anterior outline of head viewed from above, flattened; vertex a little longer than its anterior width; anterior margin of vertex less convex and plainly shorter than the frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 11:3. Pronotum nearly twice to twice the length of the head; lateral margins concave and moderately divergent; the margin more concave in females than in males; anterior angles slightly embracing the eyes, but rounded; lateral ledge broader anteriorly in the female than in the male, as seen from the side, strongly curved, pronounced on anterior half, only a ridge and curved on posterior half; margin of prothorax shorter than the rear margin of the eye below it. Anterior lobe of membrane of hemelytra a little longer than the posterior one. Anterior trochanters of male with moderate hook. Mesotrochanters rounded. The carina of fourth abdominal sternite bare. The terminal abdominal sternite of female narrow, broader at tip, which is broadly incised. First pair of gonapophyses short. Male genital capsule as shown on Plate XI.

Location of Types. In the Kirkaldy collection at U. S. N. Museum at Washington.

Comparative Notes. Described by Kirkaldy as a variety of *N. mexicana* A. & S., but really a distinct species. Kirkaldy described the red and black females as *N. mexicana* var. *ceres* and the black males as *N. mexicana* var. *hades.* I have pointed out previously that these are a single species. This species is smaller than *N. mexicana* A. & S. and a trifle larger than *N. hoffmanni* Hungerford. It is distinguished from the former by the less acute anterior angles of the prothorax and from the latter by having the lateral margins of prothorax concave.



N. ceres stirtoni

N ceres ceres

TEXT FIGURE 6. *Notonecta ceres stirtoni* Hungerford and *N. ceres ceres* Kirkaldy. Underside of abdomen of females. (Subgenus Erythronecta.)

Data on Distribution. Costa Rica: San Jose, C. R. 1160 M. August, 1905, P. Biolley.; La Palma, 1600 M. P. Biolley (Det. by Kirkaldy as var. of *N. mexicana*) ; Rio Sarapiqui, Alt. 2,000 m. Heinrich Schmidt; Rio. Virilla, December 26, 1931, Heinrich Schmidt; R. Susio, H. Rogers.

Notonecta ceres stirtoni new subsp.

(Text figure 6)

1928. *N. mexicana* var. *ceres,* Kirkaldy; Hungerford, Pan. Pac. Ento., iv, No. 3, p. 119. (Taken mating with var. *hades.*)

In this subspecies the lateral margins of the prothorax of the male are almost straight as seen from above. In the female the penultimate sternite projects broadly in the middle, whereas in *N. ceres* Kirk. the portion of the sternite surpassing the segment is narrow.

Location of Types. Francis H. Snow Coll. From El Salvador, C.A.

Notonecta ceres rogersi Hungerford, 1932

(Color Plate II, fig. 12)

1932. *N. rogersi* Hungerford, Jl. Kansas Ento. Soc., v. p. 55.

This subspecies is larger than the typical form. The male clasper is almost identical with *N. ceres* Kirk. When I described this species I was confusing *N. ceres stirtoni* with *N. ceres* Kirkaldy. I have one female which I assign to this subspecies. In this red and black specimen the lateral margins of pronotum are constricted in front of the middle instead of near the middle as in typical *N. ceres* Kirkaldy.

Notonecta impressa Fieber, 1851

1851. *N. impressa* Fieber, Rhynchotographieen Abh. Böhm. Gesel. Wis. (5), vii, p. 475.

1897. *N. impressa* Fieber; Kirkaldy, Trans. Ento. Soc. London, 1897, p. 403 (Made it a synonym of *N. insulata* Kirby in error).

1901. *N. impressa* Fieber; Champion, Biologia Centr. Americana, Rhynchota, ii, p. 368 (Places doubtfully under *N. mexicana* A. & S. in error).

1908. *N. impressa* Fieber; Kirkaldy and Bueno, Proc. Ento. Soc. Washington, x, p. 198 (Places as syn. of *N. insulata* Kirby in error).

1917. *N. impressa* Fieber; Van Duzee, Cat. of Hemiptera of America, p. 453.

1925. *N. impressa* Fieber; Hungerford, Can. Ento., lvii, p. 241 (Says not *N. insulata* Kirby).

Size. Female nearly 14 mm. long.

Shape. Much like *N. montezuma* Kirkaldy; eyes less prominent; pronotum transversely crossed by a strong depression that does not extend to the margins.

Color. A red and black species. The head and limbs of usual color; scutellum black; hemelytra red with black markings such as in *N. montezuma* Kirkaldy.

Structural Characteristics. Head not prominent; the face deeply depressed with surface transversely wrinkled; a longitudinal ridge extending from the depression to the labrum; anterior margin of vertex : synthlipsis : : 6.7 : 2.7. Pronotum and head sloping downward. Scutellum large. Hemelytral suture short. Mesotrochanter rounded. Ventral abdominal keel without hairs on the ridge. Last abdominal sternite of female broad, short and depressed on the sides.

Location of Type. In the Zoölogical Museum at Berlin I found a female specimen labeled, *"Notonecta impressa"* "3623, a green label "Mexico Westw.," a green label "Impressa Fieb." This fits Fieber's description exactly! The head is not prominent. The synthlipsis : anterior margin of vertex : : 2.7 : 6.7, as seen from above with the body horizontal. The pronotum slopes downward, and the head follows the same slope; the face is deeply depressed, the surface of the depression uneven and transversely wrinkled. Below the depression there is a median longitudinal ridge to the labrum;

transverse wrinkles across this part of the face; labrum cross-wrinkled. The pronotum is tranversely crossed just in front of the middle by a depression that does not extend to the margins of the pronotum, which are straight. The anterolateral angles embrace the eyes; lateral margins are moderately ledged. Mesotrochanter is rounded; ventral abdominal keel is without hairs on the ridge. The comparative longitudinal measurements from above are as follows: Head : Pronotum : Scutellum : Hemelytral suture (from tip of scutellum) : tip of hemelytral suture to wing tip :: 2.5 : 4.9 : 5.7 : 3.7 : 10+.

Comparative Notes. The color is quite like *N. montezuma* Kirkaldy, but it is a little smaller than the female *N. montezuma* Kirkaldy from Valentine, Texas, with which I compared it. The eyes seem smaller and the pronotum embraces the eyes a little more. The eyes seem flatter on top and the transverse pronotal depression more marked. The shape of the last ventral abdominal plates is the same in both females. While I am retaining *N. montezuma* Kirkaldy as a separate species, an examination of a long series may discover specimens like Fieber's female. Since *N. montezuma* Kirkaldy in the Hope Collection came from the Westwood Collection, according to information given by Professor Poulton to Mr. Champion, instead of "West Mexico" as Kirkaldy recorded, there is additional doubt about Kirkaldy's species being specifically different from Fieber's.

N. impressa Fieber is not *N. compacta* Hungerford, which also has transversely depressed pronotum. My *N. compacta* has sides of pronotum strongly constricted, *N. impressa* Fieber does not. It is not *N. mexicana* A. & S., because the lateral edge of the prothorax of *N. impressa* Fieber is straight and the ledge is even and longer, the pronotum longer, head smaller, scutellum very large, and the hemelytral suture short. *N. impressa* Fieber is not *N. kirbyi* Hungerford, which has a much wider synthlipsis.

Notonecta montezuma Kirkaldy, 1897

(Color Plate II, fig. 1; Plates X, fig. 2, and XV fig. 4.)

1897. *N. montezuma* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 402.

1901. *N. montezuma* Kirkaldy; Champion, Biol. Centrali Americana Heteroptera, vol. II, p. 369, pl. 22, figs. 8 and 9.

1904. *N. montezuma* Kirkaldy, Wien. Ento. Zeit., xxiii, pp. 94 and 132.

1905. *N. montezuma* Bueno, Jl. N. Y. Ento. Soc., xiii, p. 162. (Records specimen from California in error.*)

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* The specimen labeled "California" in the American Museum, and determined by Bueno as *N. montezuma* Kirk., is an oriental species with erroneous locality label.

1919. *N. montezuma* Kirkaldy; Hungerford, Kansas Univ. Sci. Bull., xi, pp. 168, 172 and 331.

1923. *N. montezuma* Kirkaldy; Hungerford, Kansas Univ. Sci. Bull., xiv, p. 426.

1928. *N. montezuma* Kirkaldy; Hungerford, Annals Ento. Soc. Am., xxi, p. 142, pl. ix, fig. 8. (Fig. male genital capsule and records species from Valentine, Texas.)

Size. Length, 14 mm.-15 mm.; width of pronotum, 4.8 ± mm.

Shape. A rather elongate species.

Color. A red and black species. Head and legs of usual color, often marked with green. Pronotum often having a median dark spot a little behind the anterior margin. Scutellum black. Hemelytra orange-red with black markings; the clavus may be marked with dark spots, especially at the tip where they join and form a part of an irregular black band that traverses the corium at this level; membrane black. Venter dark except the sides of prothorax beneath the ledge, the distal end of the metacoxal shields (extension of mesothoracic scutellum according to Rich 1918), the connexivum and median abdominal keel which are usually lighter in color.

Structural Characteristics. Anterior outline of the head viewed from above, rather flattened; face transversely depressed; vertex longer than its anterior width; anterior margin of vertex less convex and shorter than the anterior margin of an eye; anterior breadth of vertex : synthlipsis :: 8:3 (a little more or less); head a little more than half as long as pronotum. Lateral margins of pronotum only moderately divergent and straight; anterolateral angles somewhat embracing the eyes; lateral ledge, as seen from the side, nearly straight, faintly sigmoid and somewhat oblique, slightly longer than the rear margin of the eye below it. Scutellum large, longer than the pronotum. Hemelytral suture short, the ridge of the hemelytral suture shorter than the scutellum. Anterior lobe of membrane longer than the posterior lobe. Anterior trochanter of the male with a black pointed tubercle directed only slightly forward in place of the hook. Mesotrochanter rounded. Anteapical tooth of middle femur normal. Ventral abdominal keel smooth and thickened down the entire length of the fourth and fifth segments and a smooth space down the middle of the following segment. The terminal abdominal sternite of female short, broad and depressed on the sides. First pair of gonapophyses of female intermediate in length. Male genital capsule as shown in Plate XV, fig. 4.

Location of Types. Male and female in Hope Collection at Oxford, England. I find, upon examining the types, that Doctor Champion's descriptive notes and figures are excellent.

Data on Distribution. "W. Mexico" does not mean West Mexico, according to Professor Poulton, but simply that specimens are from Westwood's collection.

In 1928 I recorded 11 specimens taken by the University of Kansas party as follows: 10 specimens, Valentine, Texas, July 13, 1927, R. H. Beamer. One specimen, Presidio County, Texas, July 16, 1927, R. H. Beamer. Another, Alpine, June 5, 1927 (U. S. N. M.). I have also two male specimens taken by Hobart Smith near Santa Rosa, Guanajuata, Mexico, August 14, 1932. In the Stockholm Museum there is a male labeled "Mexico" "Sallé." I have also seen the specimen in the Paris Museum labeled "Nord de l'Inde 39-42" which was mentioned by Kirkaldy. The locality is indeed erroneous.

Notonecta insulata Kirby, 1837

(Color Plate III, fig. 1; Plate XV, fig. 1.)

1837. *N. insulata* Kirby, *in* Richardson's Faun. Bor. Am., iv, p. 285.

1878. *N. insulata*, Kirby; *in* Bethune reprint, p. 140; same from Can. Ento., x, p. 216.

1851. *N. insulata* Kirby; Fieber, Rhynchotographieen, p. 479.

1851. *N. insulata* Kirby; Fieber, Rhynchotographien, p. 55 (Van Duzee's Catalogue.).

1876. *N. insulata* Uhler; Bull. U. S. Geol. Geog. Surv. II, p. 73. (Remarks about Baltimore, Md., specimens refer to this species.)

1878. *N. insulata* Kirby; Uhler, Proc. Boston Soc. Nat. Hist., xix, p. 442, "No. 17 Harris' Collection July 1, 1823."

1894. *N. insulata* Kirby; Van Duzee, Bull. Buffalo Soc. Nat. Sci., v, p. 186. (Not uncommon in stagnant pools with clayey bottom.)

1897. *N. insulata* Kirby; Kirkaldy, Trans. Ento. Soc. London for 1897, p. 403 (in part).

1899. *N. insulata* Kirby; Smith, Insects of N. J., p. 144.

1902. *N. insulata* Kirby; Bueno, Jl. N. Y. Ento. Soc., x, pp. 230, 231, 232, 235.

1904. *N. insulata* Kirby; Kirkaldy, Wien. Ento. Zeit. xxiii, pp. 94 and 132.

1905. *N. insulata* Kirby; Bueno, Jl. N. Y. Ento. Soc., xiii, pp. 46, 150 and 162. Pl. vii, fig. 9 (in part).

1908. *N. insulata* Kirby; Bueno, Jl. N. Y. Ento. Soc., xvi, p. 237.

1909. *N. insulata* Kirby; Kirkaldy & Bueno. Proc. Ento. Soc. Wash., x, p. 198 (in part).

1910. *N. insulata* Kirby; Bueno, Jl. N. Y. Ento. Soc., xviii, p. 33.

1910. *N. insulata* Kirby; Smith, catalogue Ins. N. J., edn. 3, p. 169.

1913. *N. insulata* Kirby; Browne, Jl. Exp. Zoöl., xiv, p. 61.

1914. *N. insulata* Kirby; Parshley, Psyche, xxi, p. 140. (Taken on April 27, Orono, Maine.)

1917. *N. insulata* Kirby; Parshley, Occ. papers Boston Soc. Nat. Hist., vii, p. 113.

1917. *N. insulata* Kirby; Van Duzee, Catalogue Hemiptera, p. 453 (in part).

1917. *N. insulata* Kirby; Hungerford, Ento. News, xxviii, p. 175.

1918. *N. insulata* Kirby; Hungerford, Ento. News, xxix, pp. 242-244, Pl. xiv, fig. 5 (oviposition of).

1919. *N. insulata* Kirby; Hungerford, Kans. Univ. Sci. Bull., xi, pp. 168, 173, 181, 182, 186, 187, 189. Pl. viii, figs. 3 and 4 (eggs) Pl. xix, figs. 3, 4, 7. (1st instar nymph.)

1919. *N. insulata* Kirby; Hungerford, Kans. Univ. Sci. Bull., xi, p. 332, Pl. xxxi, fig. 9 (male genital capsule).

1919. *N. insulata* Kirby; Parshley, Occ. papers Mus. Zoöl. Univ. Mich. No. 71. (From Vancouver Island, probably *N. kirbyi* Hungerford.)

1923. *N. insulata* Kirby; Bueno & Hussey, Bull. Brookl. Ento. Soc., xviii, p. 107.

1923. *N. insulata* Kirby; Bueno, Conn. St. Geol. & Nat. Hist. Survey Bull. No. 34, pp. 405 and 407. Pl. xvi, fig. 8 (Mar. & Apr.).

1926. *N. insulata* Kirby; Leonard, Cornell Univ. Agri. Exp. Sta. Memoir 101, p. 139. (March to November.)

1926. *N. insulata* Kirby; Blatchley, Heteroptera . . . p. 1052 (in part).

1926. *N. insulata* Kirby; Hungerford, Bull. Brookl. Ento. Soc., xxi, p. 195.
1929. *N. insulata* Kirby; Hutchinson, Annals S. Afr. Mus., xxv, pt. 3, p. 364.

Referring to this species, also:

1851. *N. rugosa* Fieber, Rhynchotographieen, pp. 476-477 and his varieties *bicolor, plagiata* and *cordigera* from eastern U. S. but not his *basalis* from Brazil.
1897. *N. impressa* Kirkaldy (not Fieber) Trans. Ento. Soc. London for 1897, p. 403.
1897. *N. insulata* Kirkaldy, Trans. Ento. Soc. London for 1897, p. 404. His varieties *odora* and *geala*.
1917. *N. insulata* var. *geala* Kirkaldy; Van Duzee, Catalogue Hemiptera, p. 453.
1917. *N. insulata* var. *odora* Kirkaldy; Van Duzee, Catalogue Hemiptera, p. 453.

Size. Length, 14 mm. to 15.5 mm.; width of pronotum, 4.5 mm. to 5 mm.

Shape. A large and rather elongate species.

Color. Pattern variable, and described by Kirkaldy under five varieties, but all intergradations occur. Some specimens are nearly immaculate; gray to light tan, but with the caudal half of pronotum darkened by black mesonotum beneath; scutellum black and a streak behind hemelytral suture infuscated; golden hairs present, especially on the corium. Other specimens are strikingly marked, the hemelytra being gray, tan and black with many individuals showing some roseate reflections, this last especially marked on freshly captured specimens. While many specimens are marked like the typical *N. glauca* L., the following may be given as the typical color pattern: Head and anterior half of pronotum grayish to testaceous, often marked with green. Limbs testaceous, often greenish, with dark coxæ; hind femora longitudinally streaked beneath. Venter dark except connexivum which is more or less testaceous, often greenish. Posterior half of pronotum darkened by the black mesonotum beneath it. Scutellum black. Hemelytra with clavus gray or tan except at tip, which is spotted with black; corium with black or brown maculations near base and often along the margin, a transverse black band, broadening laterally, starting from end of hemelytral suture, behind which is a tan or roseate, roughly triangular spot, that is quite characteristic for the species; membrane and distal angle of corium dark; membrane near the tip may be traversed by a testaceous or tan band; corium and anterior lobe of membrane especially, clothed with golden hairs. Dorsum of abdomen more or less orange, metaxyphus typically yellow.

Structural Characteristics. Head about one-half length pronotum, transverse; vertex slightly longer than its anterior width; anterior margin of vertex less convex, plainly shorter than the frontal margin of the eye and projected beyond it; anterior breadth of vertex : synthlipsis : : 2—:1; synthlipsis usually slightly less than one-half width of the eye. Pronotum about twice the length of the head; lateral margins only moderately divergent, nearly straight; anterior angles normal; lateral ledge narrow, nearly straight and but slightly oblique. Anterior lobe of membrane slightly longer. Anterior trochanters of male with a small hook beyond the middle. Mesotrochanter not angulate. Carina of the fourth ventral abdominal segment bare on keel. The terminal abdominal sternite of female broad, short and only slightly incised at tip. Female gonapophyses (first pair) of intermediate length. Male genital capsule as shown on Plate XV.

Location of Type. This species was described from a single specimen. I have failed in my endeavor to locate this type.

Comparative Notes. This species in certain particulars appears to be a connecting link between the subgenera Notonecta and Paranecta, as pointed out by Hutchinson (1929). It is one of our largest American species. Its American relatives are *N. kirbyi* Hungerford long confused with it, and *N. montezuma* Kirkaldy. While this species is often found in collections with *N. undulata* Say, it is readily distinguished by its larger size. The last abdominal sternite of the female is but shallowly incised at tip, while it is deeply incised in *N. undulata* Say. The male genital capsules are quite different also.

Data on Distribution. The distribution given in Van Duzee's catalogue embraced, of course, *N. kirbyi* Hungerford. Its true range appears to be the states north of the fortieth degree of latitude and east of the one hundredth meridian and the region of Canada adjacent thereto.

The records based upon my own observations are:

UNITED STATES OF AMERICA

MAINE: Maine (Ohio State Univ.)

NEW YORK: Ithaca, April 29, 1926; July 17, 1917, H. B. Hungerford; Albany, April, 10, 1886 (Uhler Coll.); White Plains, August 22, 1907 (U. S. N. M.); Long Island, H. Meeske (U. S. N. M.); Staten Island, September 3, 1926 (U. S. N. M.); West Point, September 9, 1917, W. Robinson; also, April 22, 1926 (U. S. N. M.); Lake Side (N. Y.?), September 22, October 18, November 16 (Uhler Coll.)

NEW JERSEY: Madison (Uhler Coll.); Palisades, August 3, 1923 (U. S. N. M.).

CONNECTICUT: Hartford, October, 1892. (U. S. N. M.); Milford, March 21; New Canaan, April 3, 1919 (see Conn. Geol. & Nat. Hist. Surv. Bull. 34).

MASSACHUSETTS: Woods Hole (U. S. N. M.); Wellesley, October 10 (Uhler Coll.).

MARYLAND: Mt. Zion Valley, August 16 (Uhler Coll.).

OHIO: Cuyahoga Co., June 1, 1912, C. J. Drake.

MICHIGAN: Cheboygan Co., August 7, 1930, July 20, 1930; Douglas Lake, Cheboygan Co., July 29, 1928, July 26, 1926; Pellston Rd. Pool, July 20, 1930. The same pool, August 3, 1932; Mackinac Island State Park, August 19, 1925. All taken by H. B. Hungerford; Ann Arbor, March 7, 1894, Wolcott (Nebr. U.).

MINNESOTA: Grand Marais, August 13, 1922; Pelican Rapids, August 22, 1922. Itasca Park, Green Lake, August 21, 1922. St. Louis Co., August 14, 1922. All taken by H. B. Hungerford.

CANADA

NEWFOUNDLAND: Kelligrews, August 26, 1922, F. Johansen; (Ottawa, Can.).

QUEBEC: Knowlton, July 30, 1929, L. J. Milne (newly emerged); (Ottawa, Can.).

ONTARIO: E. Ottawa, May 12, 1930, G. S. Walley. (Ottawa, Can.).

Other Biological Notes. Long ago Doctor Uhler pointed out that this insect prefers cool waters. Van Duzee has reported it in stagnant pools having clayey bottoms near Buffalo, N. Y. I found it a rather rare insect around Ithaca, N. Y., but in Michigan, in a gravel-pit pool, I took seventy-six specimens in a couple of hours. This pool contained cold water about two feet deep at the west end and shallower and warmer water elsewhere. Most of the specimens were taken in the cold water, where they were swimming slowly on an even keel about midway between the bottom and top. They are able to remain for a long time submerged, their backs covered with a silvery film of air. At Ithaca, N. Y., the species wintered as an adult; eggs were attached to submerged vegetation during the last of April and in May. The incubation period was twenty-four days.

Notes on *Notonecta rugosa* Fieber

In the Zoölogical Museum at Berlin there are nine specimens in the row labeled *N. rugosa* Fieb. They are labeled as follows:

First: "3628" "Baltim. Klug." "Rugosa Fieb." The last looks like Fieber's writing.

Second: "Cat. No. 3628" "Nov. Granada-Gond" (I cannot be sure of this written label.) "*Notonecta rugosa* Fieb. and below it another "*rugosa* Fieb. *undulata* Say."

Third: "Cat. No. 3628" and a green label I cannot read with certainty. "Massachut. Zim."? *Notonecta rugosa* Fieb."

Fourth: Cat. No. 3628" "Massachus. Zimmerm" *Notonecta rugosa* Fieb.

Fifth: Labeled as above. This is a darker specimen than the four above.

Sixth and Seventh: Labeled as above.

Eighth: "3629" "Mexico Deppe" "*Notonecta rugosa* var."

Ninth: "3630" "Baltim. Klug." "*N. rugosa* var." This is a white specimen.

All of the above except No. 8 are *N. undulata* Say, and the first specimen looks as if it were Fieber's determination label. The eighth one is a dermestid-eaten female. It is not *N. undulata* Say, but I do not know what to call it.

Doctor Fieber described his *N. rugosa* as "Länge, 7⅓-7½ linien." The specimens here in Berlin are only 5½ English lines. Doctor Kirkaldy places *N. rugosa* Fieb. as a synonym of *N. insulata* Kirby, no doubt being influenced by Fieber's name and by his statement of length. Fieber named four varieties: variety *bicolor* and variety *plagiata* from "Longisland, Baltimore (Mus. Berol. und Hal.)," var. *cordigera* from "Pennsylvanien (Dr. Germar), Baltimore (Mus. Berol.)," and var. *basalis* from "Brazilien (Mus. Berol.)." In Kirkaldy's Uber Notonectiden, p. 94, he says that Doctor Breddin sent him from the Halle Museum a specimen labeled *N. rugosa*, but that it was a variety of *N. undulata* Say and too small to be Fieber's *N. rugosa*.

I have seen no species from Brazil (except *N. nigra* Fieb.) that is as large as *N. insulata* Kirby. Doctor Fieber recorded his var. *basalis* as from Brazil. I did not find it in the Vienna Museum. *N. rugosa* Fieber is either a synonym of *N. insulata* Kirby credited with the same size or else is *N. undulata* Say with some strange error in Fieber's measurement. In any event, the localities in eastern United States are so well known that *N. rugosa* must be one or the other of the species named above.

Notonecta kirbyi Hungerford, 1925

(Color Plate III, fig. 4; Plate XV, fig. 2)

1925. *N. kirbyi* Hungerford. Can. Ento. lvii. p. 241, pl. 6, fig. 2.
1928. *N. kirbyi* Hungerford, Annals Ent. Soc. Amer., xxi. p. 142.
1928. *N. kirbyi* Hungerford, Ento. News. xxxix. p. 156.

Referring to this species, also:

1875. *N. insulata* Uhler; Wheeler's Rept. upon Geog. & Geol. Expl. and Surveys West of One Hundredth Meridian, Washington, vol. v. ch. xii. p. 841. (Owen's valley. Calif., by F. Bischoff.)
1876. *N. insulata* Uhler, Bull. U. S. Geol. Geog. Surv., vol. I. Bull. No. 5. 2d ser. p. 339 (Mts. of Colorado).
1876. *N. insulata* Uhler, Bull. U. S. Geol. Geog. Surv., p. 73. (Reprint from above.)
1877. *N. insulata* Uhler, Wheeler's Rept. Chief Engineer for 1877, p. 1332. (In Arizona.)
1878. *N. insulata* Uhler, Bull. U. S. Geol. Geog. Surv.. iv, p. 509. (Milk river region, Montana.)
1897. *N. insulata* var. *impressa*, Kirkaldy (not Fieber) Trans. Ento. Soc. London for 1897, p. 404.
1901. *N. insulata* Champion, Biol. Centr. Amer. Hem.-Het., II, p. 369.
1904. *N. insulata* Uhler., Proc. U. S. Natl. Mus., xxvii, p. 364.
1905. *N. insulata* Bueno, Jl. N. Y. Ento. Soc., xiii, p. 46 (in part).

1906. *N. insulata* Snow, Trans. Kansas Acad. Sci., xx, pt. 1, p. 181.
1909. *N. insulata* Kirkaldy and Bueno, Proc. Ento. Soc. Wash, x, p. 198 (in part).
1914. *N. insulata* Van Duzee, Trans. San Diego Soc. Nat. Hist. II, p. 33.
1917. *N. insulata* Van Duzee, Catalogue Hemiptera, p. 453 (in part).
1919. *N. insulata* Parshley, Occas. Papers Mus. Zoöl. Univ. of Mich., No. 71, 1919. (Probably.)
1922. *N. insulata* Hungerford, Kansas Univ. Sci. Bull., xiv, pp. 417-419.
1922. *N. insulata* Parshley, S. Dakota St. College Tech. Bull. No. 11, p. 22 (from Capa, Jones Co., S. D.)

Size. Length, 13.8 mm. to 15.5 mm.; width of pronotum, 4.5 mm. to 4.8 mm.

Shape. A rather elongate species.

Color. Variable. Some specimens nearly like *N. insulata* Kirby, but usual pattern considerably darker; limbs usually less distinctly longitudinally striped. Typical color pattern tan and black or red and black. The clavus and basal half of corium tan, orange or red mottled more or less with black. Distal half of corium and basal three-fifths of membrane typically black, the black field of the corium broken only by two small spots colored like the clavus. (These spots may be large and confluent giving a triangular patch like that of *N. insulata* Kirby.) Corium and anterior lobe of membrane especially clothed with golden hairs. Dorsum of abdomen in the red forms nearly always reddish; metaxyphus typically black. The venter dark except connexivum.

Structural Characteristics. Head less than one-half length of pronotum, transverse; vertex longer than its anterior width; anterior margin of vertex less convex, as long as the frontal margin of the eye and projected beyond it; anterior breadth of vertex : synthlipsis : : 2 — : 1; synthlipsis usually fully one-half to two-thirds width of an eye. Pronotum more than twice as long as the head; lateral margins only moderately divergent, nearly straight; anterior angles normal or slightly embracing the eye; lateral ledge a little thicker than in *N. insulata* Kirby, oblique and slightly sigmoid. In side view the rear portion of pronotum more elevated than in *N. insulata* Kirby. Anterior lobe of membrane slightly longer. Anterior trochanter of male with a small hook beyond the middle. Mesotrochanter not angulate. Carnia of the fourth ventral abdominal segment bare on keel. The terminal abdominal sternite of female broad, short and only slightly incised at tip. Female gonapophyses (first pair) of intermediate length. Male genital capsule as shown on Plate XV.

Location of Type. In the Francis Huntington Snow Entomological Museum at the University of Kansas. Holotype, allotype and paratypes from Emery county, Utah, Aug.-Sept., 1921, Mrs. Grace Wiley.

Comparative Notes. This species has long been confused with *N. insulata* Kirby, from which it can be distinguished as indicated in the key.

Data on Distribution. This species has been confused heretofore with *N. insulata* Kirby. The distribution is western United States and Canada. I have the following records:

CANADA

BRITISH COLUMBIA: Mt. Cheam, Mar. 9, 1924; Bearfoot Mt., Sept. 3, 1917 (U. S. N. M.); Vernon, Aug. 5, 1931, L. D. Anderson; Vernon, Sept. 26, 1929 (Ottawa, Can.); Peachland, Oct. 7, 1921, A. N. Gartrell; Rolla, Aug. 6, 1927, P. N. Vroom; Revelstoke Mt., 6,000 ft., Aug. 12, 1923, E. R. Buckell; Creston, July 15, 1926, A. A. Dennys; Princeton, May 6, 1923, P. N. Vroom; Brents L. Summerland, Oct. 29, 1931, A. N. Gartrell; Copper Mts., Oct. 26, 1928, G. Stace Smith; Oliver, July 24, 1923, E. R. Buckell; Minnie L., July 26, 1925, N. Criddle; Aspen Grove, May 26, 1922, P. N. Vroom; (above in Ottawa, Can.).

ALBERTA: Tofield, Aug. 25, 1923, E. H. Strickland; Cypress Hills, July 21, 1930, J. H. Pepper; Waterton Lakes, July 2, 1930, J. H. Pepper; Medicine Hat, Aug. 7, 1929, J. H. Pepper.

UNITED STATES OF AMERICA

S. DAKOTA: Capa, Jones Co., June 1, 1921, H. C. Severin (S. D. St. College).

NEBRASKA: Monroe Canyon, Sioux Co., August 15, 1908, J. T. Zimmer (Nebr. U.); Pine Ridge, July (Ohio St. Univ.).

COLORADO: Pingree Park, Aug. 25, 1921, Lawson & Beamer; Northern Colo., Aug. 25, 1920, R. C. Moore; Caisson, July 1, 1931, L. D. Anderson; Colorado 819 (Uhler Coll.); Colorado Mts., July to Sept. (Uhler Coll.); Colorado 2063 Gillette (Uhler Coll.); Denver, B. H. Smith (Uhler Coll.); Colorado, C. F. Baker (U. S. N. M.); Hamilton, July 3, 1928 (newly emerged); Ft. Collins, Aug. 7, 1900, Aug. 11, 1899, Sept. 1, 1926, Sept. 8, 1926, Sept. 14, 1916, Sept. 18, 1928, Sept. 19, 1931, Oct. 2, 1917, Oct. 5, 1931, Oct. 30, 1930, Nov. 1, 1926 (Ft. Collins Exp. Sta.).

TEXAS: Valentine, July 13, 1927, R. H. Beamer; Presidio, July 16, 1927, R. H. Beamer.

NEW MEXICO: Torrance Co., July 21, 1929, P. W. Oman; Estancia, Sept. 6, 1929, C. H. Martin; Cocorro Co., Aug. 18, 1927, R. H. Beamer; Messilla Park, July 18, 1927, L. D. Anderson; Las Vegas, Barber & Schwarz (U. S. N. M.).

ARIZONA: Yavapai Co., July 1, 1929, L. D. Anderson; Cochise Co., July 20, 1927, R. H. Beamer; Gila Co., Aug. 5, 1927, R. H. Beamer; Santa Cruz, Aug. 7, 1927, P. A. Readio; Santa Rita Mts., July 25, 1927, R. H. Beamer; Navajo Co., Aug. 15, 1927, R. H. Beamer; Coconino Co., Aug. 13, 1927, P. A. Readio; Douglas, San Bernardino Ranch, 3,700 ft., Aug., F. H. Snow; Baboquivaria Mts., F. H. Snow; Arizona (Uhler Coll.); Yuvapai Co. (U. S. N. M.); Senator Mine, near Prescott, Sept. 12, 1907; Flagstaff, Barber & Schwarz (U. S. N. M.); Lowell (Uhler Coll.); Chiricahua Mts., Pinerey Canyon, Boy Scout Camp, June 17, 1932, D. K. Duncan; Reservation Springs, 12 miles N. E. of Globe, Sept. 17, 1932, D. K. Duncan; Peach Springs, Aug. 27 (Ohio State Univ.).

UTAH: Emery Co., Aug. 2, 1921, Grace O. Wiley; Emery Co., July 22 and 29, 1921, Grace O. Wiley; Emery Co., Sept. 13, 1921, Grace O. Wiley; Farwest, C. J. D. Brown; Salt Lake Co., July, 1929; Kane Co., Summer, 1921, R. C. Moore; Garfield Co., Aug. 14, 1921, R. C. Moore; Antelope, July 1, 1931, L. D. Anderson; Ogden, June 27, 1910, F. T. Moore (U. S. N. M.); Salt Lake (U. S. N. M.); Lehi, May 27, 1930, G. F. Knowlton (Knowlton Coll.).

NEVADA: Sunnyside, C. T. Brues, 1930, Hot Sp. Exp., 1930, Sp. No. 97; Bottle Mountain; Fallon, Aug. 9, 1929, L. D. Anderson; Carson City, Aug. 9, 1929, R. H. Beamer; Meadow, Nev. Hot Sp. Expd., 1930, Sp. No. 113, Gerlach & Soldier; Reno, Feb. 13, 1916, H. G. Dyar (U. S. N. M.); Owens Valley (Uhler Coll.); Vacity (Uhler Coll.).

CALIFORNIA: Bautista Canyon, Apr. 8, 1931, C. H. Martin; Emery, May 14, 1921, C. T. Dodds; Oakland, Feb. 22, 1921, C. T. Dodds; Laguna Beach, C. T. Dodds; Laguna Mts., July 6, 1929, P. W. Oman; Alpine, July 9, 1929, L. D. Anderson; San Diego Co., July 28, 1929, P. W. Oman; Cuyamaca Lake, July 6, 1929, P. W. Oman; Giant Forest, July 28, 1929, P. W. Oman; Indio, July 24, 1929, L. D. Anderson; Palo Alto, Mar. 5, 1892 (Cornell); Giant Forest, Seq. Nat. Park, July 21, 26, 1907, 6,000-7,000 ft., J. C. Bradley (Cornell); Fish Springs, Hot. Sp. Expd., 1930, C. T. Brues; San Francisco (labeled by Uhler *N. impressa* Fieb.) (Uhler Coll.); San Luis Obispo (U. S. N. M.); Sonoma Co., (U. S. N. M.); San José, Sept. 8, 1881 (U. S. N. M.); Menlo Park, Jan. 1905, F. Hornung; Santa Barbara Co., Coquillet (U. S. N. M.); San Diego Co., Coquillet (Uhler Coll.); California, Aug., C. V. Riley (Uhler Coll.); California, L. Lethierry (labeled *N. mexicana*) (U. S. N. M.); Santa Clara Co., Baker (U. S. N. M.); Placer Co., Aug. (U. S. N. M.); Palm Springs, H. G. Hubbard (U. S. N. M.); Mt. Diablo (U. S. N. M.); S. California (Uhler Coll.); San Antonio Canyon, Ontario, July 25, 1907; Campo. Calif., Laguna Mts., Aug. 25, 1932, H. W. Capps.

OREGON: Gaston; Corvallis, Sept. 4 (C. J. Drake); Dilley (H. G. Barber); Hood River, July 17, 1931, L. D. Anderson; Boardman, July 17, 1931, L. D. Anderson; Union, July 13, 1931, L. D. Anderson; Hot Lake, July 13, 1931, L. D. Anderson; Oregon (Uhler Coll.); Corvallis, Aug. 8, 1925 (U. S. N. M.); Mt. Hood Lodge, Parkdale, alt. 3,500 ft., July 30, 1931, M. C. Lane (U. S. N. M.); Warner Lake, 1877 (Uhler Coll.).

WYOMING: Yellowstone Nat. Park, Aug. 2, 1926, George Cady; Grand Teton Nat. Park, Aug. 8, 1931, L. D. Anderson; Ft. Laramie, Horn (Uhler Coll.); Grand Teton Nat. Park, Aug. 1931, L. D. Anderson.

IDAHO: Burley, July 6, 1931, L. D. Anderson; Bliss, July 7, 1931, L. D. Anderson; Soldier, (Nebr. U.); Council, June 25, 1926, alt. 3,059 ft.; Moscow, Oct. 1928, alt. 2,560 ft.

WASHINGTON: Pullman; L. McElroy, Paha, 1920; Kalama, July 21, 1931, L. D. Anderson; Coulee City, Sept. 2, 1920, M. C. Lane (U. S. N. M.); Lind, May 13, 1921, M. C. Lane (U. S. N. M.); Stratford, Sept. 3, 1920, M. C. Lane (U. S. N. M.); Ritzville, May 17, 1921, M. C. Lane (U. S. N. M.); L. McElroy, Paha, June, 1920, M. C. Lane (U. S. N. M.); Pullman, C. V. Piper (U. S. N. M.).

MONTANA: Glacier Park, Aug. 20, 1926, George Cady; Anaconda, Aug. 12, 1931, L. D. Anderson; Whitehall, Aug. 31, 1931, L. D. Anderson; Three Forks, July 7, 1931, L. D. Anderson.

Notonecta irrorata Uhler, 1879

(Color Plate I, fig. 1; Plates X, fig. 4, and XVI fig. 1.)

1879. *N. irrorata* Uhler, Proc. Boston Soc. Nat. His., xix, p. 443.

1888. *N. irrorata* Uhler; Provancher, Pet. Faune Ento. Can., iii, p. 200.

1891. *N. irrorata* Uhler; Summers, Bull. Agr. Exp. Sta., Univ. of Tenn., iv, No. 3, p. 82.

1894. *N. irrorata* Uhler; Van Duzee, Bull. Buf. Soc. Nat. Sci., v, p. 186. (Not infrequent in stagnant, muddy pools about Buffalo, N. Y.)

1897. *N. irrorata* Uhler; Kirkaldy, Trans. Ento. Soc. Lond. for 1897, p. 418.

1900. *N. irrorata* Uhler; Osborn, Contr. Dept. Zoöl & Ent. Ohio St. Univ, No. 2 p. 79.

1902. *N. irrorata* Uhler; Bueno, Jl. N. Y. Ento. Soc., x, pp. 230, 231, 235.

1904. *N. irrorata* Uhler; Kirkaldy, Wien, Ento. Zeit., xxiii, p. 132.

1905. *N. irrorata* Uhler; Bueno, Jl. N. Y. Ento. Soc. xiii, pp. 46, 159; pl. vii, fig. 6.

1907. *N. irrorata* Uhler; Bueno and Brimley, Ento. News, xviii, p. 435. (March to November four newly transformed August 8, N. Car.)

1908. *N. irrorata* Uhler; Bueno, Jl. N. Y. Ento. Soc., xvi, p. 238.

1909. *N. irrorata* Uhler; Kirkaldy and Bueno, Cat. of Am. Aquatic and Semiaquatic Hemiptera, Proc. Ento. Soc. Wash, x, Nos. 3 and 4, p. 198.

1910. *N. irrorata* Uhler, Smith, Cat. Ins. N. J., edn. 3, p. 169.

1913. *N. irrorata* Uhler; Browne, Jl. Exp. Zoöl., xiv, p. 61.

1914. *N. irrorata* Uhler; Parshley, Psyche, xxi, p. 140. (May 22-September 19, Orono & Machias, Maine.)

1914. *N. irrorata* Uhler; Barber, Bull. Am. Mus. Nat. His., xxxiii, p. 499. (From Florida.)

1917. *N. irrorata* Uhler; Hungerford, Ento. News, xxviii, p. 271.

1917. *N. irrorata* Uhler; Parshley, Occasional papers of the Boston Soc. of Nat. His., vii, p. 112. (Me., N. H., Vt., Mass., R. I., Conn.)

1917. *N. irrorata* Uhler; Van Duzee, Cat. of Hemiptera. pp. 450, 451.

1918. *N. irrorata* Uhler; Hungerford, Ento. News, xxix, pp. 242-245; pl. xiv, figs. 1-4; pl. xv, fig. 9. (Illus. ovipositor.)

1919. *N. irrorata* Uhler; Hungerford, Kans. Univ. Sci. Bull., xi, pp. 32, 33, 166. 167, 171, 177, 180-185, 187, 304, 319, 312, 339; pl. xix, figs. 2, 6, 9; pl. xxii, figs. 1-5; pl. xxiii, fig. 9.

1923. *N. irrorata* Uhler; Bueno, Conn. State Geol. and Nat. Hist. Survey Bull., xxxiv, pp. 405, 406, figs. 44, 45; pl. xvi, fig. 7. (April to November.)

1923. *N. irrorata* Uhler; Bueno and Hussey, Bull. Brook. Ento. Soc., xviii, pp. 105, 106.

1925. *N. irrorata* Uhler; Hungerford, Annals Ento Soc. Am., xviii, p. 417.

1925. *N. irrorata* Uhler; Hungerford and Beamer, Ento. News, xxxvi, p. 297. (Kansas Record new.)

1926. *N. irrorata* Uhler; Leonard, Cornell Univ. Agri. Exp. Sta. Memoir 101, p. 138. (March to November.)

1926. *N. irrorata* Uhler; Hungerford, Bull. Brook. Ento. Soc., xxi, p. 194.

1926. *N. irrorata* Uhler; Blatchley, Heteroptera of Eastern N. A., p. 1052.

1928. *N. irrorata* Uhler; Hungerford, Ento. News, xxxix, p. 156. (Georgia.)

1928. *N. irrorata* Uhler; Hungerford, Annals Ento. Soc. Amer., xxi, p. 142.

1929. *N. irrorata* Uhler; Hutchinson, Annals of South African Mus., xxv, pt. 3, p. 363.

Also, referring to this species:

1878. *N. irrorata* Say; Packard, Guide to the Study of Insects, 6th Edn. p. 537. (Without description, a manuscript name of Say used in 1st Edn. 1869.)

Size. Length, 12.9 mm. to 15.5 mm.; width of pronotum, 4.5 mm. to 5 mm.

Shape. The rapid divergence of the lateral margins to the pronotum from the comparatively small head give the appearance of a broad-shouldered back swimmer.

Color. General color is irrorated or mottled brown and blue-black or black. Head, limbs and connexivum of usual color, or a little darker, often greenish. Pronotum of same color, but darkened on caudal part by the black mesonotum beneath and marked by a median dark brown blotch in front. Scutellum black. Hemelytra irrorated with brown and black or blue-black, the brown usually predominating on the clavus and the black on the corium; the membrane is black. The venter is black. The last abdominal sternite may be testaceous or partly so, and the metaxyphus is usually margined with testaceous.

Structural Characteristics. Anterior outline of the head, as seen from above, somewhat flattened; vertex with anterior width equal to its length; anterior margin of vertex less convex and a little shorter than the frontal margin of an eye; anterior breadth of vertex : synthlipsis :: 3:1; the synthlipsis narrow, only one-third the width of the eye; the inner margins of the eyes diverging widely. Pronotum more than twice the length of the head; lateral margins quite divergent, and nearly straight; anterior angles not embracing the eyes; lateral ledge slightly sigmoid and oblique. Scutellum slightly wider than long. Lobes of membrane about equal. Anterior trochanter of male without hook or tubercle. Mesotrochanters roughly right angulate. The terminal abdominal sternite of female large and constricted near the tip, which is entire; first pair of gonapophyses long. Male genital capsule as shown on Plate XVI.

Location of Type. The type was from "Ipswich, March, Mr. Oakes; Milton, Mass., April 22, 1829." I have seen four specimens in the Boston Society of Natural History Museum (Harris Collection) that may be designated the "cotypes."

Comparative Notes. This species is related to the *Notonecta glauca* Linn. group. The long gonapophyses and the large terminal abdominal sternite of the female and the digitate process on the genital capsule of the male place it clearly with the European species. The only related species of North America is *N. borealis* Bueno and Hussey.

Biological Notes. Bueno tells us that this handsome back swimmer likes the shadows of the bank, overhanging limb, or of aquatic vegetation. I think it does prefer such places, but I have taken it in open ponds. It winters in the deeper ponds and spring-fed, open pools, flying from these quarters to shallower waters for breeding. I have seen them swimming slowly under the ice at the Field Station at Ithaca, N. Y., in early February. Mating has been observed in April in a pool in which they overwintered and from which they soon disappeared, to be found in a meadow pool a quarter of a mile away. Unlike all other North American species, except *N. borealis* Bueno and Hussey, this species inserts its eggs in the tissues of plants. One female contained 252 ova. The egg stage lasted two or three weeks in late May and first half of June at Ithaca, N. Y., where I made the above observations. After five nymphal instars the adults appeared about the middle of July.

Data on Distribution:

Canada

Quebec: Knowlton, Aug. 12, 1929, G. S. Walley; Aylmer, April 20, 1927, G. S. Walley; Kazubazua, Aug. 18, 1931, G. S. Walley; Fairy Lake, Hull, Sept. 11, 1928, G. S. Walley (Ottawa, Can. Coll.); Montreal, Aug. 1903 (U. S. N. M.).

Ontario: Southampton, Sept. 13, 1927, G. S. Walley; Black Rapids, Ottawa, Aug. 25, 1927, G. S. Walley; Arnprior, Sept. 15, 1928, G. S. Walley; Merivale, May 9, 1930, G. S. Walley; Rockcliffe, Ottawa, July 2, 1928, G. H. Fiske; Ventnor, Sept. 2, 1928, J. A. Adams; Vineland Sta., Sept. 11, 1928, W. Putman. (All of above in Ottawa, Canada Collection).

United States of America

Maine: Orono, Machias, May 22 to Sept. 19 (Parshley 1914).

Massachusetts: Mass. (Uhler Coll.); Melrose Heights, Mar. 15, D. H. Clemons.

Rhode Island: R. I. (C. F. Baker Coll.).

Connecticut: Conn. (Uhler Coll.). April 24-Nov. 24. (See Conn. Geol. and Nat. Hist. Surv. Bull. 34).

New York: Ithaca, every month of year, H. B. Hungerford; New York (Uhler Coll.); Long Island (Uhler Coll.).

New Jersey: Pallisades, Aug. 23, 1903 (U. S. N. M.); Ft. Lee Dist., Oct. 10, 1903 (U. S. N. M.); Madison (Uhler Coll.); N. J. (Uhler Coll.).

Pennsylvania: Philadelphia, 1926, F. Anderson; Penn. (Uhler Coll.); Philadelphia, near Narberth Dec. 19, 1922, W. E. Hoffmann (Minn. Coll.); Hummelstown, April 1, 1917, J. N. Knull.

Ohio: Wellington, July 8, 1890 (Tenn. Coll.); Cincinnati, Dec. 30, 1923, W. E. Hoffmann (Minn. Coll.); Columbus, Sept. 26, 1914, C. J. Drake.

Indiana: Maxinkuckee; Indiana (Uhler Coll.); South Bend (U. S. N. M.); Kosciusko Co., July, 1932, G. E. Gould.

Illinois: Toledo, Aug. 1891, Harvey; Ill. (Uhler Coll.); Champaign, April, 1907, Hart and Hood; Hilliary, Mar. 23, 1907, Hart and Hood; Dubois, June 20, 1905; Johnson Co., July 20, 1877; St. Francesville, Aug. 23, 1884; Flora, Aug. 22, 1884 (above in Ill. Nat. Hist. Surv. Mus.).

Michigan: Ann Arbor, Sept. 15, 1927, E. Creaser; Bryants Bog, Douglas L., July 17, 1923, Smith's Bog, July 17, 1923, Sedge Pt. Pool, Aug. 16, 1923, Mackinac Island, Aug. 19, 1925, Trout L., Mich. Aug. 25, 1925, Nigger Creek, Mullett Lake, Aug. 4, 1925, Burt Lake, Fontinalis Run, July 7, 1923, Bois Blanc Island, Aug. 14, 1932. All above by H. B. Hungerford.

Minnesota: Grand Marais, Aug. 13, 1922, W. E. Hoffmann; Ramsey Co., Nov. 11, 1922, W. E. Hoffmann (Minn. Coll.).

MARYLAND: Crisfield, Baltimore, Frederick (all Uhler Coll.); Plummers Island, April 25, 1913; Laurel, Aug., 1909, F. B. Marshall; Annapolis, Sept. 18, 1932, Paul Oman.

DISTRICT OF COLUMBIA: Rock Creek, Aug. 31, 1906, D. H. Clemons (U. S. N. M.).

VIRGINIA: Chain Bridge, Sept. 3, 1906, D. H. Clemons; Great Falls, May 22, 1906.

TENNESSEE: Monroe Co., July 6, 1890, H. E. Summers (Ill. Nat. Hist. Surv. Mus.).

KENTUCKY: East Cairo, June 7, 1881, S. A. Forbes (Ill. Nat. Hist. Surv. Mus.); Shakertown, July 26, 1932, H. Garman (Garman Coll.).

NORTH CAROLINA: Southern Pines.

SOUTH CAROLINA: Clemson College, Mar. 19, 1927, W. E. Jones; Clemson College, Nov. 28, 1927, D. Dunavan; Jacassee, June 19, 1927; Salem, June 30, 1927, D. Dunavan (all above in S. C. Exp. Sta.); S. C. (Uhler Coll.); Hopkins, Sept., 1920, C. S. Washington (U. S. N. M.).

GEORGIA: Floyd Co., Sept. 1, 1929, Creaser and Becker; Bleckley Co., Sept. 5, 1929. Creaser and Becker; Wrens, July 22, 1930, P. W. Oman; Prattsburg, July 25. 1930. R. H. Beamer; Baker Co., Oct. 23, 1927, C. H. Martin.

FLORIDA: Gainesville, June 9, 1918, Drake; Hilliard, Aug. 19, 1930, R. H. Beamer.

ALABAMA: Prattsville, July 21, 1930, P. W. Oman; Mount Meigs, July 21, 1930, Leonard Tuthill; Ala. (Uhler Coll.).

MISSISSIPPI: Smithville, July 17, 1930, R. H. Beamer; Hamilton, July 15, 1930, P. W. Oman; Scooba, July 17, 1930, P. W. Oman; Iuka, July 14, 1930, P. W. Oman; Crowder, Aug. 30, 1925, H. M. Harris; Charleston, Sept. 7, 1925, H. M. Harris; Agricultural College, Sept. 1, 1925.

LOUISIANA: New Orleans; Baton Rouge, Mar. 9, 1929, R. M. DeCoursey.

TEXAS: Bowie Co., Aug. 16, 1928, R. H. Beamer; Texas (Uhler Coll.).

ARKANSAS: Imboden, B. C. Marshall (U. S. N. M.).

KANSAS: Douglas Co., F. H. Snow; Douglas Co., Rock Pool. Apr. 1, 1933, Carl Cummings; Doniphan Co., Aug. 25, 1924, Linsdale; Cherokee Co., Aug., 1920, Hungerford and Beamer.

ARIZONA: Arizona (Uhler Coll.).

Notonecta borealis Bueno and Hussey, 1923

(Color Plates I, fig. 4, and II, figs. 5 and 10; Plate XVI, fig. 2.)

1923. *N. borealis* Bueno and Hussey, Bull. Brooklyn Ento. Soc., xviii, pp. 104-107, fig. 1 (fig. of female gonapophyses).

1924. *N. borealis* Bueno and Hussey; Hungerford, Kansas Univ. Sci. Bull., xiv, p. 426 (says fig. labeled *N. lutea* on plate xxxi, Kans. Univ. Sci. Bull. xi, is *N. borealis* B. & H.)

1926. *N. borealis* Bueno and Hussey; Blatchley, Heteroptera. . . . p. 1053.

1926. *N. borealis* Bueno and Hussey; Hungerford, Bull. Brooklyn Ento. Soc., xxi, p. 194 (Abundant in Michigan).

1928. *N. borealis* Bueno and Hussey; Hungerford, Annals Ento. Soc. Amer., xxi, p. 142.

1928. *N. borealis* Bueno and Hussey; Hungerford, Can. Ento., lx, p. 76. (Describes dark-colored forms.)

1929. *N. borealis* Bueno and Hussey; Hutchinson, Annals of South African Museum, xxv, pt. 3, p. 363.

1930. *N. borealis* Bueno and Hussey; Walley, Can. Ento., vol. lxii, No. 4, p. 77.

Also referring to this species:

1897. *N. insulata* Kirkaldy, Trans. Ento. Soc. London for 1897, p. 405. (Specimen in Signoret's Coll. labeled *N. rugosa.*)

1904. *N. lutea* Bueno, Ento. News, xv, p. 220.

1905. *N. lutea* Bueno, Jl. N. Y. Ento. Soc., xiii, p. 160.

1908. *N. ? lutea* Kirkaldy and Bueno, Proc. Ento. Soc. Wash., x, p. 198. (Says American species is not Müller's.)

1917. *N. lutea* Van Duzee, Cat. Hem. Amer. North of Mexico, p. 450.

1918. *N. lutea* Hungerford, Ento. News, xxix, p. 244, pl. xv, fig. 1 (fig. of ovipositor).

1919. *N. lutea* Hungerford, Kans. Univ. Sci. Bull., xi, p. 331.

Size. Length, 12.4 mm. to 14.2 mm.; width of pronotum, 4.3 mm. to 5.1 mm.

Shape. Plump, deep bodied, with the abdomen broader than the pronotum at the humeral angles.

Color. General color luteous, usually with a dark streak following the costal margin from the base of the hemelytra; membrane pale. Scutellum pale yellow. Pronotum, head and limbs ivory white or the last darker or streaked with brown; sometimes face and limbs more or less greenish. Venter dark. In some specimens the brown streak nearly covers the clavus, and in rare cases specimens have been encountered that have a black scutellum and hemelytra as dark as in *N. irrorata* Uhler. In such cases of melanchroism, however, the posterior lobe of the membrane remains pale.

Structural Characteristics. Anterior outline of head, viewed from above, somewhat flattened, but vertex produced beyond the eyes; vertex at least a fifth broader in front than its length; anterior margin of vertex less convex and plainly longer than the frontal margin of the eye; anterior breadth of vertex : synthlipsis : : 2.3:1. Pronotum slightly more than twice as long as the head; lateral margins divergent, slightly concave; anterior angles not embracing the eyes; lateral ledge sigmoid and oblique and shorter than the length of the eye below it. Scutellum small, slightly shorter than the pronotum. Posterior lobe of membrane shorter than the anterior lobe. Anterior trochanters of the male without hook or tubercle; mesotrochanters rounded. The terminal abdominal sternite of the female large and constricted near the tip, which is entire. First pair of gonapophyses long. Male genital capsule as shown on Plate XVI.

Location of Type. Type and paratypes in collection of J. R. de la Torre-Buneo; paratypes in collections of R. F. Hussey, H. B. Hungerford, H. M. Parshley, W. E. Hoffmann, and the Museum of Zoölogy, University of Michigan.

Comparative Notes. This species is related to *N. lutea* Müller of northern Europe from which it differs in a number of respects. Besides the differences in genitalia in both sexes, the *N. lutea* Müller has a hook on the anterior trochanter of the male. Both the head and mesofemoral spine of *N. borealis* B. & H. are relatively smaller than in the old world form.

Biological Notes. This species deposits its eggs in the tissues of aquatic plants. The eggs may be completely covered or be partially exposed. The life history of this species should be studied. Miss Lucile Rice made some observations (unpublished) on this species at the Biological Station of the University of Michigan on Douglas Lake during the summer of 1927. She found no adults before June 29th, at which time she took two, and observed many last instar nymphs. Seven of these nymphs transformed in the laboratory within the next twenty-four hours. By July 6th there were many adults in the pool. One of the adults brought in June 29th deposited an egg on July 9th. Egg laying continued till August 11th. However, none of the eggs, either from laboratory or field, showed any signs of developing during the summer. Miss Rice therefore took them to Tennessee, and some of them deposited July 22d hatched in her laboratory on December 15th.

From the collecting records which I have made about Douglas Lake, during a period of ten years, and from Miss Rice's observation, it appears that this northern species winters in the egg state.

Data on Distribution:

CANADA

QUEBEC: East Coast James Bay, Sept., 1920, F. Johansen; Natashquan, Que., Aug. 8, 10, 11, 1929, W. J. Brown (Ottawa, Can.).

BRITISH COLUMBIA: Bearfoot Mts., Sept. 17, 1903 (U. S. N. M.).

UNITED STATES OF AMERICA

MICHIGAN: Cheboygan Co., Aug. 29, 1918; Douglas L., July 4, 1926, C. H. Martin; Douglas L., July 29, 1926, H. B. Hungerford; Douglas L. (Sedge Pool), 1925 and July 6, 1923, H. B. Hungerford; Douglas L. (Bryants Bog), July 17, 1925, H. B. Hungerford; Mackinac Island, Michigan, Aug. 19, 1925, and Aug. 4, 1929, H. B. Hungerford.

MINNESOTA: Lake Co., Stony R. Camp No. 9, Aug. 16, 1922, H. B. Hungerford, H. H. Knight, W. E. Hoffmann; Hibbings, Aug. 18, 1922, H. B. Hungerford.

Notonecta melaena Kirkaldy, 1897

(Color Plate III, fig. 7; Plate XIII, fig. 11)

1897. *N. shooterii* var. *melaena* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 406.
1904. *N. shooterii* var. *melaena* Kirkaldy, Wien. Ento. Zeit., XXIII, p. 132.
1905. *N. shooterii* var. *melaena* Kirkaldy; Bueno, Jl. N. Y. Ento. Soc., XIII, p. 161.

Referring to this species, also:

1897. *N. shooterii* var. *tearca* Kirkaldy, Trans. Ento. Soc. London, 1897, p. 407.
1925. *N. distincta* Hungerford, Can. Ento., LVII, p. 241, pl. VI, fig. 4.
1928. *N. distincta* Hungerford, Annals Ento. Soc. Am., XXI, pl. IX, fig. 3.

Size. Length, 10.8 mm. to 11.7 mm.; width of pronotum, 4 mm. to 4.3 mm.

Color. A bichromatic species, the luteous forms having a tinge of orange, the pigmented forms with black scutellum and hemelytra varying from light brown to nearly black; a light-brown streak may be present along costal margin and above the claval suture; base of membrane black and tip white. Propleura mostly pale. Pro- and mesosternum dark. Abdominal venter with black maculations.

Structural Characteristics. Head less than one-half length of pronotum; vertex shorter than its anterior width as seen from above; anterior margin of vertex less convex than frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 11:7; the synthlipsis broad, slightly more than half the rear margin of an eye; inner margins of eyes concave. Pronotum steeply declivant; lateral margins of pronotum nearly straight and diverging at an angle of from 44 to 50 degrees, in the dark form slightly convex and diverging less markedly, the angle being about 42 degrees; anterolateral angle embracing the eye, more in the luteous forms than in the pigmented forms, some of which show angles but slightly acute; lateral ledge a little broader in the luteous forms and shorter than the rear margin of the eye beneath, as long as rear margin of the eye in the pigmented forms; lateral ledge faintly sigmoid, the anterior end curved downward and posterior end turned upward. Posterior lobe of membrane much reduced in luteous forms and slightly shorter in dark forms. Anterior trochanter of male with basal tubercle and stout hook characteristic of the *N. shooteri* Uhler group. Mesotrochanters rounded. Penultimate abdominal sternite of female broadly triangular, broadly notched at tip and overlapping base of following sternite, which is not notched at tip. Female gonapophyses short. Male genital capsule as shown on Plate XIII, fig. 11.

Location of Type. Kirkaldy named this as a variety of *N. shooterii* Uhler, from Mexico (Noualhier coll.). I have seen this specimen, a male, in the Paris Museum. My *N. distincta* is the same species. I have seen the pale specimens mentioned by Kirkaldy as having developed posterior lobes to the membranes and for which he proposed the varietal name *tearca*. He says: "This form I have seen only from Mexico (in Stockholm Mus. and in the Paris Mus., where it was labeled "*americana*" by Fallou)." The Paris specimens are labeled "Mexique, Coll. G. Fallou 259-95." The male has the membrane lobes subequal, but the female has them unequal like the

Colombian specimen he labeled "*ochrothoe*." As far as I can determine the luteous male with the normal posterior lobe of the membrane is an unpigmented specimen of the dark form of *N. melaena* Kirkaldy.

Comparative Notes. The pigmented forms have been confused until recently with *N. distinctoidea* Hungerford, being about the same size and color. The presence of the large hook on the anterior trochanter of the male and the penultimate abdominal sternite of female notched, separate this species from *N. distinctoidea* Hungerford.

Notes on Distribution. Described from Mexico. Paris Museum has a series of dark forms labeled "Etat Jalisco, L. Diguet 1903." I have specimens labeled: "10 miles N. E. Leon Quanajuato, Mex. Aug. 17, 1932, Hobart Smith"; my *N. distincta* type is labeled "Comondú, Lower Calif. Chas. D. Haines, March, 1889." The two specimens I recognize as the luteous form of this species are labeled "Las Parras, Baja, Calif., W. M. Mann."

*Notonecta ochrothoe** Kirkaldy, 1897

1897. *N. shooterii* var. *ochrothoe* Kirkaldy, Trans. Ento. Soc. London for 1897, p. 407.
1905. *N. shooterii* var. *ochrothoe* Kirkaldy; Bueno, Jl. N. Y. Ento. Soc., XIII, p. 161.

Size. Length, 10.8 mm. to 11.4 mm.; width of pronotum, 4 mm. to 4.4 mm.

Color. Only the luteous form known to me, and this is pale luteous.

Structural Characteristics. Anterior outline of head, viewed from above, convex; vertex usually shorter than its anterior width; margin of vertex less convex than margin of the eye; anterior breadth of vertex : synthlipsis : : 3:2. Pronotum not markedly declivant; pronotum more than twice length of head; lateral margins slightly divergent and nearly straight; anterolateral angles acute and embracing the eyes; lateral ledge, as seen from the side, nearly straight, about as long as rear margin of the eye beneath. Scutellum shorter than pronotum. Posterior lobe of membrane reduced. Anterior trochanter of male with stout hook and tuberculate projection on basal angle. Mesotrochanter rounded. The penultimate abdominal sternite of female broadly triangular, tip incised and projecting upon the base of the last sternite, which is not notched at tip.

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* Kirkaldy, 1904, in his Über Notonectiden, Wien. Ent. Ziet., XXIII, and in his Catalogue Proc. Ent. Soc. Wash., X, appears to have dropped this variety. Nevertheless I find a male in the Paris Museum from "Colombie" labeled this species by Kirkaldy, and since it is not *N. shooterii* Uhler, I make it the type and raise his variety to specific rank.

Female gonapophyses short. Male genital capsule shaped much like *N. melaena* Kirk. but with a thickened protuberance on keel.

Location of Type. In Paris Museum.

Comparative Notes. Differs from luteous form of *N. melaena* Kirkaldy by less declivant pronotum and by the thickened protuberance on the keel of the male genital capsule.

Data on Distribution. Colombia, S. A., and the following: "San Cristobel M. F. 3-7-1929"; San Diego Co., Calif., Doway Val., 4-9, 1930. C. and D. Martin.

Notonecta repanda new species

(Text figure 7)

Size. Length, 11.7 mm. to 13.8 mm.; width of pronotum, 4 mm. to 4.8 mm.

Color. Color markings as in *N. shooteri* Uhler.

Structural Characteristics. Anterior outline of head, viewed from above, less convex than in *N. shooteri* Uhler; vertex shorter than its anterior width; margin of vertex usually less convex than margin of the eye; anterior breadth of vertex : synthlipsis :: 3:2. Pronotum less than twice the length of the head; lateral margins slightly divergent and straight to slightly convex, more divergent, of course, in the dark forms; anterior angles acute and closely embracing the eyes; lateral ledge, as seen from the side, nearly straight throughout and as long or longer than the rear margin of the eye below it; anterior end of lateral ledge of pronotum broadly flattened, the ledge plainly wider beneath than the diameter of the second antennal segment. Scutellum short as in *N. shooteri* Uhler. The color forms as in *N. shooteri* Uhler. Trochanters the same. The penultimate abdominal sternite of female broadly triangular, the apex broader than in Uhler's species, but projecting upon last sternite, which is not notched at tip. Female gonapophyses short. Male capsule not elongate but compact much as in *N. melaena*.

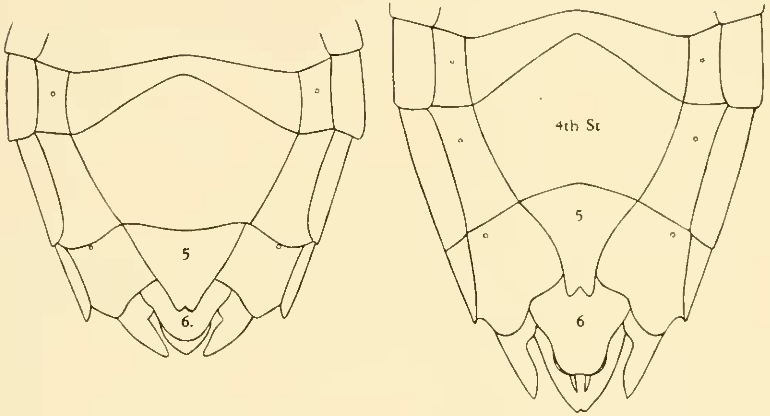
Location of Type. In the Francis Huntington Snow Entomological Museum of the University of Kansas. Described from 35 specimens labeled: "Cochise Co., Arizona, July 29, 1927, P. A. Readio, R. H. Beamer, L. D. Anderson."

Comparative Notes. This species has the appearance of *N. shooteri* Uhler, but the lateral ledge of the pronotum is more explanate, the genital capsules of males different and the penultimate abdominal sternite of female broader in the portion that overlaps the last segment.

Data on Distribution:

ARIZONA: Cochise Co., July 29, 1927 (type series); Baboquivari Mts., July 18, 1932, R. H. Beamer; Douglas, Aug., San Bernardino Ranch, 3,750 feet, F. H. Snow.

MEXICO: D. F. Texoco Sea, Jan. 31, 1926, A. Dampf.; Mexico D. F., Apr. 22, 1910; D. Fedrl. L. Conradt (U. S. N. M.); Xochimilco Lake, near Mexico City, June 2, 1926, A. Dampf.



N. repanda   N shooteri

TEXT FIGURE 7. *Notonecta repanda* Hungerford and *Notonecta shooteri* Uhler. Underside of abdomen of females. (Subgenus Bichromonecta.)

Notonecta shooteri Uhler, 1894

(Color Plate I, fig. 6; Plate XIII, fig. 8, Text fig. 7)

1894. *N. shooterii* Uhler; Proc. Calif. Acad. Sci. (2), iv, p. 292.
1897. *N. shooterii* Uhler; Kirkaldy, Trans. Ento. Soc. London for 1897, p. 406 (in part).
1901. *N. shooterii* Uhler; Champion, Biol. Centr. Amer., Hem.-Het. II, p. 370 (in part).
1904. *N. shooterii* Uhler; Kirkaldy, Wien. Ento. Zeit., xxiii, pp. 94 and 132.
1905. *N. shooterii* Uhler; Bueno, Jl. N. Y. Ento. Soc., xiii, p. 161.
1909. *N. shooterii* Uhler; Kirkaldy & Bueno, Proc. Ent. Soc. Wash., x, p. 199.
1916. *N. shooteri* Uhler; Browne, Jl. Morph., xxvii, p. 129 (Cytology).
1917. *N. shooterii* Uhler; Van Duzee, Catalog Hemipt., p. 453 (in part).
1918. *N. shooterii* Uhler; Hungerford, Ento. News, xxix, p. 245, pt. xv, fig. 8. (Ovipositor.)
1919. *N. shooterii* Uhler; Hungerford, Kans. Univ. Sci. Bull., xi, pp. 168, 172, 181, 312, 331; pl. xxiii, fig. 8, pl. xxxi, fig. 5.
1922. *N. shooterii* Uhler; Hungerford, Kans. Univ. Sci. Bull., xiv, p. 426.
1923. *N. shooterii* Uhler; Bueno & Hussey, Bull. Brookl. Ent. Soc., xviii, p. 106.
1924. *N. shooterii* Uhler; Hale, Proc. Lin. Soc. N. S. Wales, xlix, pt. 4, p. 462.
1928. *N. shooterii* Uhler; Hungerford, Annals Ento. Soc. Amer., xxi, p. 143; pl. ix, fig. 5. (Anterior trochanter of male.)
1928. *N. shooterii* Uhler; Hungerford, Can. Ento., lx, p. 76.
1929. *N. shooterii* Uhler; Hutchinson, Annals S. Afr. Mus., xxv, pt. iii, p. 364.

Size. Length, 11.7 mm. to 13.5 mm.; width of pronotum, 4.4 mm. to 4.8 mm.

Color. A bichromatic species. One form pale luteous with or without a submarginal stripe and one or two elongate triangular brown spots on corium. The other form dark, with black scutellum and brown hemelytra, which are streaked and spotted with pale luteous, the pale markings being a broad streak on clavus, a transverse irregular spot at end of basal third of corium, a spot at distal end of corium and another on anterior lobe of membrane. The posterior lobe of membrane may be pale to nearly black. The abdominal venter luteous with brown maculations in both color phases. Face, limbs and connexivum may be yellowish or suffused with green.

Structural Characteristics. Anterior outline of head, viewed from above, convex; vertex usually longer or subequal to its anterior width; margin of vertex more convex than margin of the eye; anterior breadth of vertex : synthlipsis : : 9.3:5.5. Inner margins of eyes slightly concave. Pronotum usually less than twice the length of the head; lateral margins slightly divergent and straight to slightly convex; anterolateral angles acute and closely embracing the eyes; lateral ledge, as seen from the side, straight in front, undulate behind, shorter than the rear margin of the eye below it, and nearly horizontal. Scutellum short, about as long as pronotum and shorter than ridges of hemelytral commissure. Anterior lobe of membrane much longer and more developed than the posterior lobe in luteous phase and plainly longer in the dark phase. The luteous forms, besides the reduced posterior lobe of hemelytra, have the flight wings reduced, and this is accompanied by a reduction in the prominence of the humeri and in the size of the scutellum. The reduced humeri cause the lateral margins of the pronotum to appear more nearly parallel. Anterior trochanters of the males with broad, stout hook in usual position and in addition a tuberculate projection on basal angle (see plate IX, fig. 4). Mesotrochanter rounded. The penultimate abdominal sternite of female elongate triangular, the sides converging caudally, tip incised and projecting upon the base of last sternite, which is not notched at tip. Female gonapophyses (first pair) short. Male genital capsule as shown on Plate XIII.

Location of Type. In the Uhler collection at the U. S. N. M., Washington, D. C. The type series was found near San Diego, California, on October 19, by Mr. Shooter, for whom Doctor Uhler named the species. The spelling of the name might have been *N. shooteri.*

Comparative Notes. This species is typical of a group that have the large, stout hook on anterior trochanters of the males and females, with the penultimate sternite elongate triangular, thus intermediate between the *N. mexicana* A. & S. series and the *N. undulata* Say group. The males readily recognized by the elongate portion of the capsule behind the keel protuberence.

Data on Distribution. The group as a whole ranges from California to Colombia, S. A., but the species *N. shooteri* Uhler appears to be restricted to California. I have the following records:

CALIFORNIA: Marin Co., Aug. 3, 1929, L. D. Anderson; Winters, Aug. 6, 1929, L. D. Anderson; Campo, Laguna Mts., Aug. 25, 1932, H. W. Capps; Fresno, June 20, 1926, C. J. Drake; Laguna Beach, C. T. Dodds; Los Angeles (Uhler Coll.); San Diego, Oct. 19, Mr. Shooter (Uhler Coll.).

"VITI-INS": Distant coll. 1911-383 (British Mus.).

Notonecta uhleri Kirkaldy, 1897

(Color Plate III, fig. 9; Plate XIII, fig. 10)

1897. *N. uhleri* Kirkaldy, Annals & Mag. Nat. Hist., ser. 6, xx, p. 58.

1897. *N. uhleri* Kirkaldy, Trans. Ento Soc. London, 1897, p. 415.

1902. *N. uhleri* Kirkaldy; Bueno, Jl. N. Y. Ento. Soc., x, pp. 231, 235.

1904. *N. uhleri* Kirkaldy, Wien. Ento. Zeit, xxiii, p. 132.

1905. *N. uhleri* Kirkaldy; Bueno, Jl. N. Y. Ento. Soc., xiii, pp. 46 and 157, pl. vii, fig. 4.

1906. *N. uhleri* Kirkaldy; Bueno and Brimley, Ento. News, xviii, p. 436.

1909. *N. uhleri* Kirkaldy and Bueno, Proc. Ento. Soc. Washington, x, No. 3-4, p. 199. (Cat. of Am. Aquatic & Semiaquatic Hemiptera.)

1910. *N. uhleri* Kirkaldy; Smith, Cat. Ins. N. J., edn. 3, p. 169.

1914. *N. uhleri* Kirkaldy; Barber, Bull. Am. Mus. Nat. Hist., xxxiii, p. 499.

1917. *N. uhleri* Kirkaldy; Parshley, Occasional Papers of the Boston Society of Natural History, vii, p. 112.

1917. *N. uhleri* Kirkaldy; Van Duzee, Catalog of Hemiptera, p. 451.

1918. *N. uhleri* Kirkaldy; Hungerford, Ento. News, xxix, p. 245, Pl. xv, fig. 10.

1919. *N. uhleri* Kirkaldy; Hungerford, Kans. Univ. Sci. Bull., xi, pp. 167, 170, 180, 181, 312, 331; Pl. xxiii, fig. 10.

1923. *N. uhleri* Kirkaldy; Bueno, Conn. State Geol. & Nat. Hist. Survey Bull. No. 34, p. 405.

1923. *N. uhleri* Kirkaldy; Hungerford, Kansas Univ. Sci. Bull., xiv, p. 426. (Mention only).

1926. *N. uhleri* Kirkaldy; Blatchley, Heteroptera of Eastern North America, p. 1055.

1926. *N. uhleri* Kirkaldy; Leonard, Cornell Univ. Agri. Exp. Sta. Memoir 101, p. 138, (Apr. to Nov.)

1928. *N. uhleri* Kirkaldy: Hungerford, Ento. News, xxxix, p. 156.

Size. Length, 10 mm. to 12 mm.; width across pronotum, 3.3 mm. to 4 mm. The males usually smaller than the females.

Shape. The males at least are slender.

Color. Orange to brick red and black. Anterior half of pronotum, head, limbs and underside of connexivum of usual color or a little darker and sometimes greenish; a dark linear longitudinal band usually present on pronotum behind the caudolateral margin of the eye. Scutellum black. Hemelytra orange to brick red; corium crossed by broad, irregular black band extending from near tip of clavus to costal margin. Posterior lobe, at least of membrane, dark, and both lobes crossed by black or nearly black band that often covers the lobes to their tips and sometimes darkens entire membrane. The hemelytra usually clothed with silvery hairs that are more pronounced on the corium; a few such hairs may also be seen on scutellum. The venter is dark.

Structural Characteristics. Anterior outline of the head, as seen from above, slightly convex; vertex longer than its anterior width and "shaped like an inverted wine-decanter"; anterior margin of vertex shorter than the frontal margin of an eye; the anterior breadth of vertex : synthlipsis : : 6 or 8:1; the eyes at synthlipsis often nearly contiguous and their inner margins curved. Head shorter than length of pronotum. Lateral margins of pronotum strongly divergent and moderately concave; anterior angles normal; lateral ledge, as seen from the side, curved (convex above), oblique and plainly shorter than the rear margin of the eye below it. The scutellum plainly longer than the pronotum and also longer than the ridge of the hemelytral suture. Lobes of membrane subequal, the anterior lobe sometimes slightly longer. Anterior trochanter of the male with a slight tubercle in place of a hook. Mesotrochanter right-angulate or slightly produced. Terminal abdominal sternite of female carinate and slightly notched at tip; the first pair of gonapophyses short. The male genital capsule as shown on Plate XIII, fig. 10.

Location of Type. In the P. R. Uhler collection at the U. S. N. Museum.

Comparative Notes. The small size, the reddish and black color and the very narrow synthlipsis readily distinguish this species.

Data on Distribution. A Uhler specimen is labeled "Stony Run, Pa." "Among grass in water." In the Paris Museum I found a specimen compared with type by Kirkaldy labeled "Mus. Paris, Neue Orleans, Coll. Guérin Menev. ex. coll. A. Salle, 1897." The British Museum has specimens from Mass. The Uhler collection from Florida and Massachusetts. Bueno reports it from New York, Washington, D. C., New Jersey and Louisiana. Doctor Drake took it at Gainesville, Florida. Doctor Blatchley adds: Maryland, North Carolina and southern Illinois. There are specimens in the University of Kansas collection labeled as follows: "Boardman, N. C., Sept. 21, 1915, R. W. Leiby"; "Raleigh, N. C., Oct. 16, 1905, C. S. Brimley"; "Florence, S. C., July 2, 1930, D. Dunavan (Clemson College Coll.);" "Putnam Co., N. Y."; "Leland, Miss., 9-14-21";

"Baker Co., Ga., Oct. 23, 1927, C. H. Martin"; "Prattsburg, Ga., 7-25-1930, R. H. Beamer"; "Hilliard, Fla., 8-31-30, Paul W. Oman"; "Norfolk, Va., 8-15-28, G. E. Gould;" also "Oct. 1, 1932, L. D. Anderson; Annapolis, Md., Sept. 18, 1932, Paul Oman."

Thus *N. uhleri* Kirkaldy has been taken in the following states: Mass., New Jersey, Pa., N. Y., Md., Va., Dist. of Columbia, Ill., N. Carolina, La., Ga., Fla., Miss. The range, so far as we know it, extends, therefore, from Massachusetts south to Florida and westward to the Mississippi river.

Notonecta raleighi Bueno, 1907

(Color Plate I, fig. 7; Plate XIII, fig. 6)

1907. *N. raleighi* Bueno, Can. Ento. xxxix, p. 225.

1907. *N. raleighi* Bueno and Brimley, Ento. News, xviii, p. 436. (Feb. to Nov. in N. Carolina.)

1909. *N. raleighi* Bueno; Kirkaldy & Bueno, Proc. Ento. Soc. Wash., x, p. 199.

1910. *N. raleighi* Bueno; Smith, Catalog Ins. N. J., edn. 3, p. 169.

1917. *N. raleighi* Bueno; Van Duzee, Catalog Hemip., p. 452.

1918. *N. raleighi* Bueno; Hungerford, Ento. News, xxix, p. 245, pl. xv, fig. 2. (Fig. of ovipositor.)

1919. *N. raleighi* Bueno; Hungerford, Kans. Univ. Sci. Bull., xi, pp. 167, 169, 181, 239, 331; pl. xxiii, fig. 2.

1923. *N. raleighi* Bueno; Conn. St. Geol. & Nat. Hist. Survey Bull. No. xxxiv, pp. 404-405.

1925. *N. raleighi* Bueno; Hungerford & Beamer, Ento. News, xxxvi, p. 297.

1926. *N. raleighi* Bueno; Leonard, Cornell Univ. Agri. Exp. Sta. Memoir 101, p. 139. (March, White Plains, N. Y. det. Bueno.)

1926. *N. raleighi* Bueno; Blatchley, Heteroptera . . . p. 1055.

1930. *N. raleighi* Bueno; Hungerford, Bull. Brookl. Ento. Soc., xxv, p. 140.

Referring to this species, also:

Probably some specimens prior to 1907 were included under *N. variabilis* Fieber in error.

Size. Length, 8 mm. to 8.9 mm.; width of pronotum, 2.5 mm. to 2.9 mm.

Color. A pale species that may be pale yellowish throughout or with scutellum black save for lateral margins and hemelytra more or less smudged with black. Bueno says: "Scutellum ranges from pure light yellowish to black, disk margined with smoky orange-yellow on hemelytral margins. Hemelytra ranging from white with vague beginnings of the corial fasciæ and black humeri with white membrane, through all intergrades to a form with a blackish stripe along the anterior margin of the corium; black margins to the clavus along the scutellar edges; a black streak along the corium near to and parallel to the claval suture; black corial fasciæ merging into the black membrane which shade off into smoky and then white at apex. One of the types is the most pronouncedly melanic specimen of the species in a series of sixty or so specimens. In this the extreme of scutellar darkness with orange-red edges obtains. The external edges of the clavus are broadly black, shading into smoky to the corial suture; the dark band on the corium parallel to this suture is broad; the humerus has a black streak running into the corium, which is dark luteous, except for the black fasciæ which coalesce with the black membrane, which in turn lightens to smoky at the apex."

Structural Characteristics. Our smallest North American species. Anterior outline of head somewhat rounded, vertex and eyes in nearly an even curve: vertex slightly longer than its anterior width; anterior margin of vertex about equal to the frontal margin of the eye. Anterior breadth of vertex : synthlipsis :: 5:1, often less. Synthlipsis usually less than one-fourth the width of the eye. Pronotum two- to four-tenths longer than the head, lateral margins straight, divergent, anterior angles normal to slightly embracing the eyes, lateral ledge a little bowed and oblique as seen from the side. Membrane lobes subequal. Anterior trochanters of male with minute hook; mesotrochanter right angulate to acutely angulate (one specimen with rounded trochanter). Terminal abdominal sternite of female incised at tip, male genital capsule as shown on Plate XIII.

Location of Types. Described from sixteen specimens from Raleigh, N. C. Types: Collections U. S. National Museum, American Museum of Natural History, C. S. Brimley and Bueno.

Comparative Notes. Although this species was described as having "vertex more than six times as wide as synthlipsis," I have seen no specimens with such a narrow synthlipsis. Many specimens from the type locality, some determined by Bueno, have come under my observations. In my "Biology of Aquatic and Semiaquatic Hemiptera" I separated this species from *N. variabilis* (now *N. lunata*) as follows:

"Vertex 3 times synthlipsis.............................. *N. variabilis.*
Vertex 6 times synthlipsis.............................. *N. raleighi.*"

I took these statements from the literature, and Doctor Blatchley, in his "Heteroptera,"[6] used the same statements. The problem of separating these species is by no means so simple. After studying much material involving an examination of all specific characters known to me I must confess my failure to find definite distinctive characters. All gradations appear to occur. The male genitalia are not clearly distinguishable. Typical specimens of *N. raleighi* Bueno are smaller and synthlipsis is narrower than in the form we know as *N. lunata* Hungerford. The latter appear to be the common form in New York state and in Michigan, while the former is more southern in distribution.

Notonecta lunata Hungerford, 1926

(Color Plate I, fig. 5; Plate XIII, fig. 5)

1926. *N. lunata* Hungerford, Psyche, xxxiii, p. 12. (new name for *N. variabilis maculata* Fieb.).

1926. *N. lunata* Hungerford, Bull. Brooklyn Ento. Soc., xxi, p. 195.

1928. *N. lunata* Hungerford, Annals Ento. Soc. Amer., xxi, p. 143.

1930. *N. lunata* Hungerford, Bull. Brooklyn Ento. Soc., xxv, p. 140.

Referring to this species, also:

1851. *N. variabilis* var. *maculata* Fieber, Rhynchotographieen, p. 477.

1851. *N. variabilis* var. *maculata* Fieber, Rhynchotographien, p. 53 (Van Duzee).

1878. *N. undulata* Uhler, Proc. Boston Soc. Nat. Hist., xix, p. 442 (var. Σ).

1885. *N. undulata* Uhler, Stand. Nat. Hist., II, p. 252 (in part).

1897. *N. variabilis* Kirkaldy, Trans. Ento. Soc. London for 1897, p. 414 (the N. A. forms).

1899. *N. americana* Ashmead, Smiths Ins. N. J., p. 144 (Bueno).

1901. *N. variabilis* Champion, Biol. Centr. Amer. Hem.-Het., II, p. 370.

1902. *N. variabilis*, Bueno, Jl. N. Y. Ento. Soc., x, pp. 231 and 234.

1904. *N. variabilis* Kirkaldy, Wien. Ento. Zeit., xxiii, p. 95 (in part).

1905. *N. variabilis* Bueno, Jl. N. Y. Ento. Soc., xiii, pp. 45 and 155.

1908. *N. variabilis* Bueno, Jl. N. Y. Ento. Soc., xvi, p. 238.

1909. *N. variabilis* Kirkaldy and Bueno, Proc. Ento. Soc. Wash., x, p. 199 (in part).

1910. *N. variabilis* Smith, Catalog Ins. N. J., edn. 3, p. 169.

1910. *N. variabilis* Bueno and Brimley, Ento. News, xviii, p. 435.

1912. *N. variabilis* Bueno, Can. Ento., xliv, p. 213.

1914. *N. variabilis* Parshley, Psyche, xxi, p. 140. (Apr. to Sept. in Maine.)

1914. *N. variabilis* Barber, Bull. Am. Mus. Nat. Hist., xxxiii, p. 499 (Florida).

1917. *N. variabilis* Hungerford, Ento. News, xxviii, p. 267.

1917. *N. variabilis*. Parshley, Occ. Papers of Boston Soc. Nat. Hist., vii, p. 112.

1917. *N. variabilis* Van Duzee, Catalog Hem., p. 451.

1918. *N. variabilis* Hungerford, Ento. News, xxix, pp. 242, 243, 245; Pl. xv, fig. 4 (Ovipositor).

1919. *N. variabilis* Hungerford. Kans. Univ. Sci. Bull., xi, pp. 22, 167, 169, 170, 180, 181, 186, 187, 193; Pl. viii fig. 4; Pl. xix, figs. 1, 5, 8, 11, 13; Pl. xxiii, fig. 4.

1919. *N. variabilis* Hungerford, Kans. Univ. Sci. Bull., xi, pp. 331, 332; Pl. xxxi, fig. II (male genital capsule).

1923. *N. variabilis* Bueno, Conn. St. Geol. and Nat. Hist. Survey Bull., No. 34, pp. 404, 405; Pl. xvi, fig. 5. (May to Oct.)

1925 *N. variabilis*, Hungerford, and Beamer, Ento. News, xxxvi, pp. 264 and 297.

1926. *N. variabilis* Leonard, Cornell Univ. Agri. Exp. Sta., Memoir 101, p. 139. (Mar. to Nov.)

Size. Length, 8.5 mm., to 10.7 mm.; width of pronotum, 2.8 mm. to 3.5 mm.

Color. A pale species from nearly white to yellowish with scutellum nearly always yellowish. Head, pronotum and limbs often greenish. Hemelytra only occasionally with a smoky band in corium and a spot near tip of corium.

Structural Characteristics. Difficult to distinguish from *N. raleighi* Bueno. Vertex slightly shorter than anterior width; anterior margin of vertex slightly longer than frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 3:1; synthlipsis usually about a third the width of an eye. Pronotum four- to six-tenths longer than the head; lateral margins nearly straight, divergent; anterior angles normal, lateral ledge nearly straight and oblique as seen from the side. Membrane lobes about equal, anterior lobe may be trifle longer. Anterior trochanters of male with the usual small hook, mesotrachanters acutely angulate, terminal abdominal sternite of female incised at tip. Male genital capsule as in *N. raleighi* Bueno. (See plate XIII, fig. 5.)

Location of Type. *N. lunata* was a name proposed to replace the name *N. variabilis* var. *maculata* Fieber, a name previously used. I have not been able to find any specimens from Baltimore in the Berlin Museum that might have been studied by Fieber. Whether Fieber had *N. raleighi* Bueno or *N. lunata* Hungerford is impossible to determine. By general consent both were called *N. variabilis* until Bueno described *N. raleighi,* leaving the larger forms to be called *N. variabilis.* As I have pointed out, *N. variabilis* Fieb. must be a South American form.

I have labeled a series of insects from Ithaca, N. Y., as typical of *N. lunata* Hungerford. They are in the Francis Huntington Snow collection at the University of Kansas.

Data on Distribution. The following records have been furnished by G. S. Walley, who has kindly determined the specimens in the Ottawa collection and given me the data:

CANADA

NEW BURNSWICK: Ludlow, July 7, 1928; W. J. Brown.

QUEBEC: Fairy Lake, Hull, May 3-17, 1927, G. S. Walley; May 16, 1928, W. J. Brown; Sept. 11, 1928, G. S. Walley. Knowlton, Aug. 12, 1929, G. S. Walley. Missisquoi Bay, July 11, 1927, G. S. Walley. Brome Lake, July 8, 1927, G. S. Walley.

ONTARIO: Black Rapids, Ottawa, Apr. 27, May 11, 1927, G. S. Walley. Jock River, Ottawa, Apr. 20, May 21, Aug. 25, 1927, G. S. Walley. Britannia, Aug. 21, 1927, W. J. Brown. Ventnor, Aug. 5, Sept. 1, 1928, J. A. Adams. Chesley Lake, Aug. 23, 1928, G. S. Walley. Arran Lake, June 20, 1921, G. S. Walley. Southampton, Sept. 13, 1927, G. S. Walley. Dundas, May 31, 1931, G. S. Walley. Pt. Pelee, June 3, 6, 1929, G. S. Walley and L. J. Milne. Leamington, July 6, 1931, G. S. Walley.

Notonecta unifasciata unifasciata Guérin, 1857

(Color Plate I, fig, 12; Plate XIV, figs. 1, 2, 3.)

1857. *N. unifasciata* Guérin-Meneville, Le Moniteur Universel, 26 Nov., 1857, Numéro 330, p. 1298.

1857. *N. unifasciata* Guérin-Meneville, Revue et Magasin de Zoölogie, 2d ser., Tom. ix, pp. 522-527.

1858. *N. unifasciata* Guérin-Meneville, L'Illustration, Tom. xxxii, p. 47, Juillet 17,1858.

1858. *N. unifasciata* Guérin-Meneville, Comptes Rendus, Nov. 23, 1857, p. 865. (From Annals & Mag. ref. below.)

1858. *N. unifasciata* Guérin-Meneville, Annals and Mag. of Nat. Hist. (3), I, p. 79. (Eng. review.)

1858. *N. unifasciata* Guérin-Meneville, Bull. Soc. Zoöl. Acclim. iv, p. 581, 1857.

1858. *N. unifaciata* Guérin-Meneville, Bull. Soc. Ento. Fr. (3) v, pp. cxlviii - cli.

1897. *N. unifasciata* Guérin; Kirkaldy, Trans. Ento. Soc. London for 1897, p. 426. (Says unknown to him.)

1898. *N. unifasciata* Guérin; Kirkaldy, Ento. Mon. Mag. (2) ix (Old ser., vol. xxxiv), p. 173. (Says: "doubtless *N. americana* Fabr.)

1899. *N. unifasciata* Guérin; Kirkaldy, Ento., xxxii, (Says = *N. undulata* Say.)

1917. *N. unifasciata* Guérin; Hungerford, Ento. News, xxviii, p. 181.

1929. *N. unifasciata* Guérin; Hungerford, Pan Pacific Ento., vi, No. 2, pp. 73-77. (Report on the type.)

1930. *N. unifasciata* Guérin; Hungerford, Can. Ento., lxii, p. 218.

1930. *N. unifasciata* Guérin; Hungerford, Bull. Brooklyn Ento. Soc., xxv, p. 139.

1933. *N. unifasciata* Guérin; Ancona, Anales del Inst. de Biol. IV, p. 68. (Mexico.)

Referring to this species, also:

1897. *N. americana* Kirkaldy, Trans. Ento. Soc. London for 1897, p. 409. (In part: Spec. Det. by him in Vienna and Paris.)

1899. *N. americana* Kirkaldy, Revue d'Entomologie, xviii, p. 94 (Desc. of egg).

1900. *N. indica* Kirkaldy, Ento., xxxiii, p. 10.

1901. *N. undulata* Champion, Biol. Centr. Amer., Hem.-Het., ii, p. 370 (in part).

1904. *N. indica* Kirkaldy, Wien, Ento. Zeit., xxiii, p. 95.

1905. *N. indica* Bueno, Jl. N. Y. Ento. Soc., xiii, pp. 149, 151; pl. vii, fig. 1.

1906. *N. indica* Snow, Trans. Kans. Acad Sci., xx, pt. 1, p. 181.

1909. *N. indica* Kirkaldy & Bueno, Proc. Ento. Soc. Wash., x, p. 198.

1916. *N. indica* Browne, Jl. Morph., xxvii, pp. 119-162. (Cytology.)

1917. *N. indica* Van Duzee, Catalogue Hemipt., p. 452.

1917. *N. indica* Hungerford, Ento. News, xxviii, p. 175.

1918. *N. indica* Hungerford, Ento. News, xxix, pp. 243, 245; pl. xv, fig. 11.

1919. *N. indica* Hungerford, Univ. Kans. Sci. Bull., xi, pp. 167, 168, 181, 332; pl. xxiii, fig. 11. (Ovipositor) pl. xxxi, fig. 6.

1928. *N. indica* Hungerford, Ento. News, xxxix, p. 156.

Size. Length. 9.3 mm. to 10.2 mm.; width of pronotum, 3.3 mm. to 3.6 mm.

Color. Typically black and white. Scutellum black with lateral margins flavous. Hemelytra white with black markings; clavus often black along inner margin and apex; distal end of corium and basal two-thirds of membrane crossed by solid black band.

Structural Characteristics. Anterior outline of head, as seen from above, somewhat flattened; vertex shorter than its anterior width; anterior margin of vertex less convex and longer than frontal margin of an eye; anterior breadth of vertex : synthlipsis : : 5:3. Pronotum slightly more than twice as long as the head; lateral margins nearly straight and moderately divergent; anterior angles somewhat acute and embracing the eyes; lateral ledge oblique. Anterior lobe of membrane longer than the posterior. Anterior trochanter of male with medium-sized hook. Mesotrochanters angulate. Terminal abdominal sternite of female relatively broad and not plainly notched at tip. Female gonapophyses short. Male genital capsule as shown on Plate XIV.

Location of Types. Museum of Paris. Kirkaldy in his "Revision" listed the species as an "Unrecognized species," but I found the types in the Paris Museum in a box prepared by Guérin labeled "Hautlé." For a full report of this discovery see my paper in the Pan-Pacific Entomologist, volume VI, p. 73, 1929.

Comparative Notes. In general facies this is a characteristic species. The head is quite short, the black scutellum is margined with flavous and the mesotrochanter is angulate. There is some variation in the shape of the head, in the angle of the mesotrochanter and in the male claspers. The material from the type locality (near the city of Mexico), from Guadalupe, D. F. Mex., Socorro, N. M., and some specimens from Southern California, while showing some variation in the male claspers, appear to be *N. unifasciata* Guérin. The variations mentioned above make it necessary to designate subspecies as follows:

Notonecta unifasciata cochisiana new subsp.

This subspecies conforms to the general description of the species, but has a very characteristic male clasper that separates it from the typical *N. unifasciata* Guérin, see Plate XIV, fig. 5. Sixty specimens from Cochise Co., Arizona, represent the type series of this subspecies.

Notonecta unifasciata andersoni new subsp.

In this subspecies the anterior margin of vertex is more rounded and the clasper longer than in typical *N. unifasciata* Guérin. See Plate XIV, fig. 6. This is a smaller species than *N. spinosa* Hungerford, and although the shape of the head is somewhat like it the mesotrochanter does not have the long spine-like projection of the mesotrochanter so characteristic of *N. spinosa*. The type series was taken at Oliver, B. C. Material collected in Navajo, Ariz.; Carson City, Nevada; Lehi and Am. Forks, Utah; and Hot Lake, Oregon, shows a gradation away from the typical *N. unifasciata* Guérin.

Notonecta unifasciata angulata new subsp.

This subspecies conforms in general shape and appearance with the typical species, but the clasper of the male is stouter than any of the others. (See Pl. XIV, fig. 4.) The vertex of the female is more rounded. The mesotrochanter is angulate but not as produced. This subspecies is described from one male and one female in the Uhler Collection. The specimens bear the label "Kirkaldy, S. Amer."

Biological Notes. This species was described from a measure of dried insects offered for sale in Mexico as food. It formed part of a mixture of water bugs consisting largely of Corixids of two or three species, one of which Guérin described as new at the time he described this Notonectid. Collections of eggs of Corixids gathered and offered for food nearly always contain some eggs of this backswimmer. C. T. Brues took this species and its nymphs from water having a temperature of 97.3° F. He took it from a number of hot springs with temperatures of 85° F. and above.

Data on Distribution. This species (broad sense) is widely distributed from Mexico, across Western United States to Western Canada. Two specimens labeled "S. Amer." in the Uhler collection appear to be a subspecies of *N. unifasciata* Guérin.

MEXICO

D. F. Texcoco Lake, Oct. 21, 1923, Jan. 31, 1926, Alf. Dampf; Ahuatle from Lake Texcoco, L. Ancona H., 9-1-1932; Guadalupe, D. F., Aug. 31, 1903, W. L. Tower; D. F. Lago de Texcoco, May 14, 1930, Creaser-Gordon. (Mich. U.)

UNITED STATES

TEXAS: Presidio Co., July 16, 1927, P. A. Readio; Valentine, July 13, 1927, R. H. Beamer.

NEW MEXICO: Torrance Co., Sept. 10, 1925, C. H. Martin; Estancia, Sept. 6, 1925, C. H. Martin; Socorro Co., Aug. 18, 1927, R. H. Beamer.

ARIZONA: Douglas, Aug., F. H. Snow; Navajo Co., Aug. 15, 1927, R. H. Beamer; Apache Co., Aug. 16, 1927, R. H. Beamer; Maricopa Co., Aug. 7, 1929, L. D. Anderson; Cochise Co., July 20, 1927, R. H. Beamer.

CALIFORNIA: L. Elsinore, Aug. 2, 1911; Los Angeles Co., Coquillett (U.S. N. M.); San Diego Co., Poway Val, Apr. 9, 1930, C. & D. Martin; Niles Canyon, Alameda Co.; San Antonio Canyon, Ontario, July 25, 1907; Kelly Springs, Camby, C. T. Brues; Cedarville, 1930, C. T. Brues; Bassetts Hot Springs, 1930, C. T. Brues.

NEVADA: Carson City, Aug. 9, 1929, Oman, Anderson and Beamer; Soda Lake, July 14, 1911; Fallon, Aug. 9, 1929, L. D. Anderson; 37 mi. s. of Battle Mts., Tem. 30°C., C. T. Brues; Goldfield, Tem. 35.4°C., C. T. Brues; 29 mi. s. of Winnemucca, Tem. 36.3°C., C. T. Brues (nymphs also); Sunnyside, 1930, C. T. Brues; Austin, Aug. 9, 1929, P. W. Oman.

UTAH: Emery Co., Aug. 26, 1921, Grace Wiley; Garfield, July 9, 1911, Locomotive Spgs., April 10, 1930, Grantsville, April 2, 1930, Pleasant Grove, April 4, 1930, Lehi, April 4, 1930, American Fork, April 8, 1930, all by G. F. Knowlton; Farwest, Sept. 12, 1929, C. J. D. Brown; Tremonton, July 5, 1931, L. D. Anderson.

OREGON: Hot Lake, Temp. 80° F., July 13, 1931, L. D. Anderson; Boardman, July 15, 1931, L. D. Anderson; Hood River, July 17, 1931, L. D. Anderson.

CANADA

Oliver, B. C., Aug. 6, 1931, L. D. Anderson; Peachland, Oct. 7. 1931, A. N. Gartrell; Brent's Lake, Summerland, Oct. 29, 1931, A. N. Gartrell; Vernon, June 21, 1921, R. Hopping; Penticton, Oct. 14, 1931, A. N. Gartrell; Westbank, April 21, 1932, A. N. Gartrell. (All but first in Ottawa Museum.)

Notonecta spinosa Hungerford, 1930

(Color Plate II, fig. 7; Plate XIV, fig. 7)

1930. *N. spinosa* Hungerford, Can. Ento., lxii, pp. 217, 218.

Size. Length, about 12 mm., the females may be a little longer and the males a little shorter than this. Width of pronotum, 3.3 mm. to 3.6 mm.

Color. General color of *N. undulata* Say except that the black scutellum is broadly margined with orange-yellow. It is therefore a black and white species with venter dark to black; the head, limbs and venter often suffused with green; dorsal view of head and anterior part of pronotum pale horn in color, posterior part of pronotum dark, due to black mesonotum beneath. Scutellum black, broadly margined with orange-yellow, the ends of this V-shaped figure slightly broader, not attaining the base of the scutellum. Hemelytra white with sooty black markings as follows: Small, dark, irregular blotch at base that may extend as narrow line to near the middle, one as a median dark line on the membrane; a zigzag M-shaped figure, which is thin, transversing hemelytra just in front of the membrane.

Structural Characteristics. Anterior outline of head, as seen from above, roundly curved; eyes not prominent; vertex with anterior width slightly greater than its length; anterior margin of vertex broadly rounded and wider than the frontal margin of an eye; anterior breadth of vertex : synthlipsis :: 2+:1. Length of pronotum : length of head :: 3+:2; lateral margins straight and divergent; anterior angles normal; lateral ledge oblique and shorter than the rear margin of the eye beneath it. Lobes of membrane about equal. Anterior trochanter of male with a hook. Mesotrochanter with angle produced into a long, sharp spine. Terminal abdominal sternite of female with broad, but very shallow, notch at tip. Female gonapophyses (first pair) short. Male genital capsule as shown on Plate XIV.

Location of Types. Holotype, allotype and some paratypes in Francis Huntington Snow Entomological Museum in the University of Kansas. Other paratypes in U. S. National Museum; Canadian National Collection, Ottawa, Canada; Mus. of California Academy of Science and Knowlton's collection. Others have since been sent to Mr. Torre-Bueno, Mr. Esaki, the Paris Museum and the British Museum.

Comparative Notes. Size and color as in *N. undulata* Say except that the scutellum is always margined with orange-yellow. The more produced front margin of the vertex, the spinose mesotrochanter and the genitalia of both sexes separate it from Say's species. It is larger than *N. unifasciata* Guér., has a narrower synthlipsis and a long spinose mesotrochanter instead of angulate or slightly produced process as in Guérin's species.

Data on Distribution:

CANADA

BRITISH COLUMBIA: Vernon, Sept. 26, 1919, W. Downes (Ottawa, Canada); Oliver, Aug. 6, 1931, L. D. Anderson.

UNITED STATES OF AMERICA

UTAH: Lehi, April 4, 5, 8 and May 3-27 1930, G. F. Knowlton; Logan, Oct. 5, 1930, M. J. Jones; Hyde Park, April 19, 1930, G. F. Knowlton; Brigham, April 26, 1930, G. F. Knowlton; American Fork, May 3, 1930, G. F. Knowlton.

NEVADA: Carson City, Aug. 9, 1929, R. H. Beamer.

YELLOWSTONE NATIONAL PARK: Fry Pan L., Aug. 15, 1931, L. D. Anderson.

MONTANA: Whitehall, Aug. 13, 1931, L. D. Anderson; Three Forks, July 22, 1931, L. D. Anderson.

OREGON: Hot Lake, July 13, 1931, L. D. Anderson.

Notonecta indica Linné, 1771

(Color Plate I, fig. 2; Plate XIII, fig. 3)

1771. *N. indica* Linnæus, Mantissa Plantarum, ii, p. 534.

1806. *N. indica* Linnæus; Turton *in* Linn. Syst. Nat., edn. 13, Eng. Transl., ii, p. 605.

1930. *N. indica* Linnæus; Hungerford, Bull. Brook. Ento. Soc., xxv, p. 139.

Referring to this species, also:

1775. *N. americana* Fabricius, Syst. Ento., p. 690.

1811. *N. americana* Olivier, Encyclopédie Méthodique Histoire Naturelle Insectes, viii, pp. 387 and 389. "Saint Domingue."

1832. *N. undulata* Say, N. Harm., p. 39; Fitch reprint, p. 812; Compl. Writ. I, p. 368 (in part).

1851. *N. variabilis* var. *scutellaris* Fieber, Rhynchotographieen, p. 477. (Those from Portorico.)

1856. *N. variabilis* Guérin, in Ramon de la Sagra's Cuba, Hist. Nat., vii, p. 176.

1881. *N. pallipes* Lethierry, Ann. Soc. Ento. Belg., xxv, p. 13 (three specimens from St. Barthélemy).

1884. *N. undulata* Uhler, Standard Nat. Hist. II, p. 252 (in part.)

1891. *N. undulata* Summers, Bull. Agri. Exp. Sta., Univ. Tenn., iv, No. 3, p. 82 (in part).

1894. *N. americana* Uhler, Proc. Zoöl. Soc. London for 1894, p. 223 (a single nymph taken Aug. 20).

1897. *N. undulata* Kirkaldy, Trans. Ento. Soc. London, p. 410 (in part).

1897. *N. undulata* var. *charon* Kirkaldy, Trans. Ento. Soc. London, p. 411 (in part).

1899. *N. undulata* Kirkaldy, The Ento., xxxii, p. 29 (Flight to lights in Jamaica).

1901. *N. undulata* Champion, Biol. Centr. Amer. Hem. Het., ii, p. 370, Tab. xxii, fig. 10.

1905. *N. howardii* Bueno, Jl. N. Y. Ento. Soc., xiii, p. 151.

1905. *N. undulata* Bueno, Jl. N. Y. Ento. Soc., xiii, p. 153 (in part).

1909. *N. undulata* Delcourt, Bull. Sci. Fr. et Belg, Tom xliii (7), vol. 1, pl. iv, line 8.

1909. *N. undulata* Kirkaldy & Bueno, Proc. Ento. Soc. Wash., x, p. 199 (in part).

1909. *N. howardii* Bueno; Kirkaldy & Bueno, Proc. Ento. Soc. Wash., x, p. 198 (in part).

1914. *N. undulata* Barber, Bull. Am. Mus. Nat. Hist., xxxiii, p. 499.

1917. *N. undulata* Van Duzee, Catalogue Hemiptera, p. 451 (in part).

1917. *N. howardii* Bueno; Van Duzee, Catalogue Hemiptera, p. 452.

1919. *N. howardii* Bueno; Hungerford, Kans. Univ. Sci. Bull., xi, p. 168.

1919. *N. undulata* Hungerford, Kans. Univ. Sci. Bull., xi, p. 169 (in part).

1922. *N. howardii* Bueno; Hungerford, Kans. Univ. Sci. Bull., xiv, p. 426. (Says fig. 8, pl. xxxi of Sci. Bull. xi is this species).

1922. *N. howardii* Bueno; Drake, Ohio Jl. Sci., xxii, p. 116.

1926. *N. howardii* Bueno; Blatchley, Heteroptera . . . p. 1053.

1926. *N. undulata* Blatchley; Blatchley, Heteroptera . . . p. 1054 (in part).

1928. *N. howardii* Bueno; Hungerford, Ento. News, xxxix, p. 156 (Georgia).

Size. Length, 10 mm. to 11 mm.; width of pronotum, 3.36 mm. to 3.75 mm.

Color. Color variable, from luteous to nearly black, the hemelytra having only the base of the clavus tan. The typical color is black and white; the scutellum and a broad band covering the distal end of corium and the basal two-thirds of the membrane black; the scutellum often pale at tip and marked near each basal angle by a light spot.

Structural Characteristics. Head more than one-half length of pronotum; vertex as long or slightly longer than its anterior width as seen from above; anterior margin of vertex less convex and shorter than the frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 5:2; synthlipsis about two-fifths the width of the eye. Pronotum not twice length of head, lateral margins but slightly divergent on anterior two-thirds, then divergent, making the lateral margin appear concave and yet giving the appearance of a somewhat parallel sided pronotum; anterior angles embracing the eye; lateral ledge but slightly oblique and straight. Lobes of membrane equal. Anterior trochanter of male with a stout conspicuous hook. Mesotrochanter rounded. Terminal abdominal sternite of female with a shallow notch or none at tip. Female gonapophyses short. Male genital capsule as shown on Plate XIII.

Location of Type. I did not find any specimens in Upsala, Sweden, but in the Collection of the Linnean Society at London there is a male specimen. It lacks one middle leg entirely and the tibia and tarsus of the other. It still has both front legs and one hind leg (1928). The specimen has a black scutellum with flavous marks, which are irregular, as in many specimens of what we have heretofore known in America as *N. howardii* Bueno. The mesotrochanter is rounded as in Bueno's species, not angulate as in *N. unifasciata* Guér, which we called *N. indica* for many years. The label "indica" appears not to be in Linnæus handwriting. It is, however, altogether probable that this specimen was in the Linnæan collection purchased by Sir James E. Smith, who was for forty years president of the Linnean Society of London. I therefore designate it the type of *N. indica* Linn.

In the Museum at Copenhagen, under the name *Notonecta americana* Fabr., I found several specimens. The first one bears the labels: "Museum Seh. and T. Lund," "*N. americana*" and is *N. indica* Linn. It is a female specimen and the scutellum has the pale spot at each basal corner as described by Fabricius (Fabricius, however, said his specimen was from "Mus. Tottianum"). The second specimen bears one label I cannot read and another "Mus. Seh. and T. Lund." It is *N. undulata* Say. The third and fourth specimens are females labeled "Mus. Westerm" "*N. americana*" and are *N. indica* Linn. There is no doubt that the first two specimens at least were seen by Fabricius and the first one fits his description exactly.

Comparative Notes. Due to its size and color variations it has been included under *N. undulata* Say in most collections. The broad black band across the hemelytra of typical specimens separate it from typical specimens of *N. undulata* Say. The head is more truncate as seen from above. The shape of the pronotum appears more parallel sided than in Say's species. The last abdominal sternite of the female is shallowly notched, if notched, and the anterior trochanters of the male are armed with larger hooks than in *N. undulata* Say.

Data on Distribution. This is one of the few species common to both North and South America. Its range extends across the southern United States south of 37° latitude. I have seen but one collection north of this line. This is from Maryland, which indicates that east of the Allegheny Mountains it extends northward to include Maryland. Southward I have it from Mexico, Yucatan, Guatemala, Colombia, South America (Bogota), Brazil * ?, and from the Islands of Cuba, Jamaica, St. Croix, St. Thomas, and Porto Rico.

The following collections are before me:

UNITED STATES OF AMERICA

MARYLAND: Crisfield, Sept. 26, U. S. N. M. (Uhler called it *N. punctata* Fieb.).

NORTH CAROLINA: Southern Pines, Sept. 14, 1916.

SOUTH CAROLINA: Clemson College, April 13, 1929, Oct. 30, 1927, Nov. 25, 1929, D. Dunavan; Walhalla, Mar. 24, 1929, D. Dunavan.

KENTUCKY: Pond near Brooklyn Bridge, Jan. 3, 1933, H. Garmen, (taken along with *N. undulata* Say.)

TENNESSEE: Murfreesboro, Aug. 29, 1929, Creaser & Becker (Michigan); Knoxville, July 13, 1890; Neubert Springs, Dec. 1, 1932, L. Chester Marsten Jr. (34 adults and 3 nymphs).

GEORGIA: Baker Co., Aug. 24, 1927, C. H. Martin; Ga. (Uhler Coll. U. S. N. M.).

FLORIDA: Inverness, Aug. 1, 1930, J. O. Nottingham; Cocoanut Co., Aug. 9, 1930, R. H. Beamer; Archer, July 31, 1930, Paul Oman; Sanford, Aug. 4, 1930, Paul Oman; Wildwood, Aug. 2, 1930, J. O. Nottingham; Plant City, Jan. 4, 1927, C. O. Bare; Dunedin, W. S. Blatchley, Feb. 9, 1919 (Purdue Univ.).

MISSISSIPPI: Fayette, July 23, 1921; Miss. Agri. Coll., Aug. 20, 1913, J. G. Hester; Natchez, Sept. 8, 1924, H. M. Harris.

LOUISIANA: Baton Rouge, Mar. 9, 1929, R. M. DeCoursey; Mound, Mar. 9, 1929; Opelousas, C. R. Pilate (Baker Coll. U. S. N. M.); New Orleans, July, 1916, H. E. Hubert (U. S. N. M.).

ARKANSAS: Arkansas Co., Apr. 9, 1930; Fayetteville, Feb. 27, 1930; Lawrence Co., B. C. Marshall; Imboden, Mar. 19, 1925, B. C. Marshall.

TEXAS: Hidalgo Co., July 30, 1928, R. H. Beamer; Sutton Co., July 16 and Aug. 20, 1928, R. H. Beamer; Victoria Co., Aug. 9, 1928, R. H. Beamer; Victoria, Dec. 27, 1910, J. D. Mitchell (U. S. N. M.); Colorado Co., Apr. 25, 1922, Grace Wiley; Cameron Co., Aug. 13, 1928, A. M. James; Brooks Co., July 25, 1928, R. H. Beamer; Jim Wells Co., July 24, 1928, A. M. James; Valentine, July 13, 1927, R. H. Beamer; Kerrville, Apr. 11, 1907, F. C. Pratt; Calvert, July 22, 1907, C. R. Jones (U. S. N. M.); Alfred, July 24, 1932, R. H. Beamer.

NEW MEXICO: Socorro Co., Aug. 18, 1927, L. D. Anderson; Eddy Co., July 9, 1927, P. A. Readio; San Antonio, July 15, 1927, L. D. Anderson; Mesilla Park, July 18, 1927, P. A. Readio.

ARIZONA: Douglas, F. H. Snow; Gila Co., Aug. 5, 1927, R. H. Beamer; Cochise Co., July 29, 1927, L. D. Anderson; S. W. edge Tuscon, July 20, 1932, R. H. Beamer.

CALIFORNIA: Holtville, July 2, 1929, R. H. Beamer; Calipatria, July 14, 1923.

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* See p. 141 where I have called these Fieber's *N. variabilis*.

Mexico

Tamaulipas, San Carlos Mts., July, 1930, Dice & Bartlett (Michigan); Los Mochis, Senaloa, June 13, 1922, C. T. Dodds; Cuernavaca, Nov. 4, 1922, E. G. Smyth (U. S. N. M.); Guadalajara, Etat de Jalisco, M. Diguet, 1901 (labeled *N. undulata* var. *charon* Am. M. N. H.); Yucatan, Tabi, F. D. G. (labeled "B. C. A. Rhyn. II. *N. undulata* Say" U. S. N. M.).

Guatemala

S. Geronimo, Champion B. C. A. Rhyn II (labeled "*N. undulata* by Champion); Guatemala City, Ainslei (C. J. Drake).

Colombia

Bogota, Coll. Signoret (Vienna); Colombie, Steinheil (det. by Kirkaldy as *N. undulata* Paris Mus.).

West Indies

Cuba: Havana, Jan. 25, 1932, P. J. Bermudez; Havana, Baker (U. S. N. M); Soledad, Apr. 4, 1925, J. G. Myers; Littletown, Jan. 1, 1878.

Jamaica: Claremont Baron Hill, Trelawny, Mar. 4, 1928, L. G. Perkins; Montego Bay, Mar. 15, 1911 (Am. Mus. Nat. Hist.); Port Antonio, A. E. Wight (Mus. Comp. Zoöl., Cambridge, Mass.); Yardley Chase, Santa Cruz Mts., St. Elizabeth, taken at light Oct. 31, 1899.

Porto Rico: Desengano, June, 1924 (Cornell Univ. lot 719).

St. Thomas: Charlotte Amalie; V. Ids., June 2, 1917, Harold Morrison.

St. Croix: "F. 5022," Mar. 4, 1925 (Am. Mus. Nat. Hist.).

Notonecta undulata Say, 1832

(Color Plate I, fig. 3; Plates IX, fig. 3; X, fig. 3; XIII, fig. 1)

1832. *N. undulata* Say, Heter. New Harm., p. 39; Fitch's reprint, p. 812; Complete Writ. I, p. 368.

1851. *N. undulata* Say; Fieber, Rhynchotographieen p. 479 (not known to him). Rhynchotographien, p. 55 (Van Duzee).

1853. *N. undulata* Say; Herrick-Schäffer, Wanzenartigen Insecten, ix, p. 137.

1874. *N. undulata* Say; Packard, Half hours w. Insects, pt. 6, pp. 139-141, fig. 103 (Egg desc. p. 158).

1876. *N. undulata* Say; Uhler, Bull. U. S. Geol. Geog. Surv., vol. I, Bull. V, 2d ser., p. 339, pl. 21, fig. 33.

1876. *N. undulata* Say; Uhler, Bull. U. S. Geol. Geog. Surv. Reprint from above, p. 73. (Inhabits foulest pools.)

1877. *N. undulata* Say; Uhler, Bull. U. S. Geol. Geog. Surv., III, p. 453.

1877. *N. undulata* Say; Uhler, Wheeler's Rept. Chief Eng. for 1877, p. 1332. (N. Mex.)

1878. *N. undulata* Say; Uhler, Bull. U. S. Geol. Geog. Surv., iv, p. 509.

1878. *N. undulata* Say; Uhler, Proc. Bost. Soc. Nat. Hist., xix, p. 442. (Except Var. Σ.)

1878. *N. undulata* Say; Packard's Guide, 6th Ed., p. 537, fig. 542.

1884. *N. undulata* Say; Uhler, Stand. Nat. Hist., II, p. 252 (in part.)

1884. *N. undulata* Say; Popenoe, Trans. Kans. Acad. Sci., ix, p. 62.

1888. *N. undulata* Say; Comstock, Introduction, p. 186, fig. 157.

1888. *N. undulata* Say; Provancher, Pet. Faune Ent. Can., iii, p. 201.

1889. *N. undulata* Say; Weed, Bull. Ohio. Agri. Sta. Tech., ser. I, p. 12; pl. ii, fig. 3 (Feeding and defense).

1889. *N. undulata* Say; Garman, Bull. Ill. Lab. N. H., Art. ix, vol. iii, p. 174.

1890. *N. undulata* Say; Hyatt and Arms, Insecta, p. 121, fig. 70.

1891. *N. undulata* Say; Summers, Bull. Agr. Exp. U. of Tenn., iv, No. 3, p. 82.

1894. *N. undulata* Say; Uhler, Proc. Calif. Acad. Sci. (2) iv, p. 292.

1894. *N. undulata* Say; Van Duzee, Bull. Buffalo Acad. Nat. Sci., v. p. 186.

1895. *N. undulata* Say; Gillette & Baker, Bull. xxxi, Colo. Agr. Exp. Sta. Tech. ser. i, p. 63.

1897. *N. undulata* Say; Kirkaldy, Trans. Ento. Soc. London for 1897, p. 410.

1897. *N. undulata* Say; Smith, Ins. N. J., p. 144.

1899. *N. undulata* Say; Packard, Ento. for Beginners, p. 83.

1899. *N. undulata* Say; Comstock, Manual, p. 130, fig. 49.

1900. *N. undulata* Say; Osborn, Contr. Dept. Zoöl. and Ento. Ohio State Univ., No. 2, p. 79.

1900. *N. undulata* Say; Lugger, Bull. 69, Ento. Div. U. of Minn. Agr. Coll. Exp. Sta, p. 15.

1901. *N. undulata* Say; Champion, Biol. Centr. Amer. Hem.-Het., ii, p. 370 (in part).

1901. *N. undulata* Say; Howard, Insect Book., p. 275.

1902. *N. undulata* Say; Bueno, Jl. N. Y. Ento. Soc., x, pp. 231 and 233.

1904. *N. undulata* Say; Kirkaldy, Wien. Ento. Zeit., xxiii, pp. 94, 95 and 132 (in part).

1905. *N. undulata* Say; Bueno, Jl. N. Y. Ento. Soc., xiii, p. 45 (in part).

1907. *N. undulata* Say; Bueno and Brimley, Ento. News, xviii, p. 435.

1908. *N. undulata* Say; Bueno, Jl. N. Y. Ento. Soc., xvi, p. 238.

1909. *N. undulata* Say; Kirkaldy & Bueno, Proc. Ento. Soc. Wash., x, p. 199 (in part).

1909. *N. undulata* Say; Delcourt, Bull. Sci. Fr. et Belg., xliii, (7) I, pl. iv, line 6, No. 5; line 7, Nos 1, 2, 3, 4.

1910. *N. undulata* Say; Bueno, Jl. N. Y. Ento. Soc., xviii, p. 33. (Dec. and Feb. swimming under thin ice.)

1910. *N. undulata* Say; Severin, Can. Ento., xlii, p. 340. (Food habits.)

1910. *N. undulata* Say; Smith, Catalog Ins. N. J., edn. 3, p. 169.

1912. *N. undulata* Say; Bueno, Can. Ento., xliv, p. 213.

1913. *N. undulata* Say; Browne, Jl. Exp. Zoöl., xiv, p. 61. (Male germ cells.)

1914. *N. undulata* Say; Barber, Bull. Am. Mus. Nat. Hist., xxxiii, p. 499. (Cited in error.)

1914. *N. undulata* Say; Parshley, Psyche, xxi, p. 140. (May 8, Oct. 17, Orono, Maine.)

1917. *N. undulata* Say; Hungerford, Ento. News, xxviii, pp. 175-182; pl. xiii, fig. 7.

1917. *N. undulata* Say; Hungerford, Ento. News, xxviii, pp. 267-277; pls. xix and xx. (Life history.)

1917. *N. undulata* Say; Parshley, Occ. Papers Boston Soc. Nat. Hist., vii, p. 113.

1917. *N. undulata* Say; Van Duzee, Catalog, Hemipt., p. 451, 452 (in part).

1918. *N. undulata* Say; Hungerford, Ento. News, xxix, pp. 242, 243, 245; pl. xv, fig. 3 (ovipositor).

1919. *N. undulata* Say; Parshley, Occ. Papers Mus. Zoöl. Univ. Mich., No. 71, 1919.

1919. *N. undulata* Say; Hungerford, Kans. Univ. Sci. Bull., xi, pp. 21, 96, 166-169, 177, 180, 181, 184, 186, 187, 190, 193, 195, 196, 258, 259, 263, 268. Color Plate II, fig. 1 and pls. i, iv, viii, xix, xx, xxi, xxiii, xxiv. (Biology of.)

1919. *N. undulata* Say; Hungerford, Kans. Univ. Sci. Bull., xi, pp. 329, 332; pl. xxxi, fig. 10.

1921. *N. undulata* Say; Parshley, Proc. British Columbia Ento. Soc., No. 18 (Syst. Ser.), p. 24.

1922. *N. undulata* Say; Parshley, S. Dakota St. College Tech. Bull. II, p. 22.

1923. *N. undulata* Say; Bueno & Hussey, Bull. Brooklyn Ento. Soc. xviii, p. 107.

1923. *N. undulata* Say; Bueno, Conn. St. Geol. & Nat. His. Surv. Bull. No. 34, pp. 404 and 405. (April to Oct.)

1924. *N. undulata* Say; Hale, Proc. Lin. Soc. N. S. Wales, xlix, pt. 4, p. 462.

1925. *N. undulata* Say; Hungerford, Annals Ento. Soc. Amer., xxviii, p. 417.

1925. *N. undulata* Say; Comstock, Introduction to Ento., p. 362, fig. 416.

1925. *N. undulata* Say; Clark, Bull. Brooklyn Ento. Soc., xx, pp. 186 and 187.

1925. *N. undulata* Say; Hungerford & Beamer. Ento News, xxxvi, pp. 263, 264, 297.

1926. *N. undulata* Say; Leonard, Cornell Univ. Agri. Exp. Sta. Memoir 101, p. 139. (March to Nov.)

1926. *N. undulata* Say; Bare, Annals Ento. Soc. Amer., xix, p. 93. (Life history.)

1926. *N. undulata* Say; Hungerford, Bull. Brooklyn Ento. Soc., xxi, p. 195.

1926. *N. undulata* Say; Blatchley, Heteroptera . . . p. 1053.

1928. *N. undulata* Say; Hungerford, Annals Ento. Soc. Amer., xxi, pl. ix, fig. 4.

1928. *N. undulata* Say; Hungerford, Ento. News, xxxix, p. 156. (From N. M.)

1929. *N. undulata* Say; Hutchinson, Annals S. Afr. Mus. xxv, pt. 3, p. 364.

1930. *N. undulata* Say; Hungerford, Bull. Brooklyn Ento. Soc., xxv, p. 138.

Referring to this species, also:

1847. *N. glauca* Shepherd,* Sillimans Amer. Jl. (2) iv, pp. 423, 424 (migration).

1848. *N. glauca* Shepherd, Ann. & Mag. Nat. Hist. (2) I, p. 158.

1848. *N. glauca* Simpson, Quoted by Spence *in* Trans. Ento. Soc. London, v, proc. p. 36.

1851. *N. punctata* Fieber, Rhynchotographieen, p. 476. Rhynchotographien, p. 52. (Van Duzee.)

1853. *N. americana* Herrick-Schaeffer, Wanzen. Ins., ix, p. 44, fig. 902. (Color illus.—not typical for any species.)

1897. *N. undulata* var. *charon* Kirkaldy, Trans. Ento. Soc. London for 1897, p. 411 (in part).

Size. Length, 10.5 mm. to 12.6 mm.; width of pronotum, 3.6 mm. to 4 mm.

Color. Typically black and white. Head and legs of usual color, often greenish; abdominal venter usually marked with black areas; connexivum like the legs; thoracic venter dark; posterior part of pronotum darkened by the black mesonotum beneath. Scutellum black. Hemelytra white with an undulate transverse black band across apex of corium and base of membrane. The species may vary from pale luteous forms with pale scutellum to forms darker than typical, having, beside the usual black marks, distal end of clavus, a band on middle of corium and a streak on embolium nearly black. All gradations occur.

Structural Characteristics. Anterior outline of head, as seen from above, somewhat rounded; vertex about as long as its anterior width; anterior margin of vertex slightly less convex and longer than frontal margin of an eye; anterior breadth of vertex : synthlipsis : : 2 + :1. Pronotum less than twice as long as the head; lateral margins straight and moderately divergent; anterior angles slightly embracing the eyes; lateral ledge oblique. Lobes of membrane about equal. Anterior trochanter of male with a medium-sized hook. Mesotrochanter not angulate. Terminal abdominal sternite of female notched at tip, the notch deeper than wide. Female gonapophyses (first pair) short. Male genital capsule as shown on Plate XIII.

Location of Type. In the T. W. Harris collection at the Boston Society of Natural History are the specimens reported by Doctor Uhler in the Proceedings of the Boston Society of Natural History XIX, pt. 4, Apr., 1878, p. 442. In this paper, entitled "Notices of the Hemiptera Heteroptera in the Collection of the late T. W. Harris," Doctor Uhler writes concerning *N. undulata* Say: "No. 17 β Harris collection "Rivers and Ponds. Sept. 20, 1821. May 15, 1828 ♂, ♀." Determined by Mr. Say. Four varieties remain in the collection, noted β. γ. δ Σ . . .” The remaining notes by Uhler are of little interest now except to show that his own idea of the species included *N. lunata* Hungerford and *N. indica* Linn. I have examined the specimens mentioned above. β. is typical. γ. is less colored, the scutellum is yellow margined, and there is a small black spot on outer tip of embolium and corium. δ has lost its head and pronotum, the wings are pale and there is a central spot of black on scutellum. Σ is *N. lunata* Hungerford.

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* This and two following relate to a flight of backswimmers in the upper Mississippi valley, probably *N. undulata* Say, but cannot be certain.

There can be no doubt as to the identity of Say's *N. undulata* which he described from “Missouri and Indiana.” The species I have described is not only the most common species in the regions he names, but the most common and widespread back-swimmer in the United States. It is the only one with the typical undulate band and has been recognized by all American students. I have specimens from Missouri that fit Say's original description. There can be no objection in designating β. which was determined by Say as the type of *N. undulata* Say.

Comparative Notes. Kirkaldy included several distinct species under this name which lead him to give a distribution extending all the way down to Chile, S. A. There are in North America several black and white species of approximately the same size, and when pale specimens are encountered they have often been confused with *N. lunata* Hungerford. The rounded mesotrochanter separates *N. undulata* Say from *N. lunata* Hungerford, *N. unifasciata* Guér. and *N. spinosa* Hungerford, which have angulate to spinose mesotrochanters. The straight, divergent lateral margins of the pronotum, the moderate size of the hook on the anterior trochanter of the male, and the deep, narrow notch in the last abdominal sternite of the female separate it from *N. indica* Linn., which has lateral margins of the pronotum curved, conspicuous hook on anterior trochanter of male and a shallow notch, or none, in the last abdominal sternite of the female. (See, also, the key to species on page 68.)

Biological Notes. This common species has been the subject of several studies in behavior and life history. In 1917 Hungerford described and figured the elongate white egg, which is attached to submerged objects, and the five nymphal instars. In the earlier instars the food consists largely of ostracods and similar organisms. Winter is passed in the adult stage, and in Kansas there are two main broods in a season. Bare (1926) obtained the emergence of an adult in the laboratory on July 30, and 13 days later it began laying eggs. He also reared the species to maturity in from forty to fifty-two days, using mosquito larvæ as food.

Data on Distribution. This North American species ranges from coast to coast and from Canada to the Gulf. It is the most common species of the back swimmers east of the Rocky Mountains and north of the 37° of latitude. South of this line it is more and more replaced in abundance by *N. indica* Linn. as one goes southward. My data include the following:

CANADA

NOVA SCOTIA: Truro, Sept. 23, 1926, F. Johansen.

QUEBEC: Fairy Lake, May 14, 1927, and Sept. 11, 1928, G. S. Walley; Kazubazua, Aug. 18, 1927, and Aug. 28, 1928, W. J. Brown, and Aug. 18, 1931, G. S. Walley; Otter Lake, Aug. 6, 1931, G. S. Walley; Knowlton, June 21, 1927, G. W. Walley.

ONTARIO: Rockcliffe, Aug. 2, 1928, G. H. Fisk; Mer Bleue, May 28, 1927, G. S. Walley; Westboro, Sept. 10, 1928, J. A. Adams; Toronto, Sept. 18, 1930, L. J. Milne; Rondeau Park, June 13, 1929, G. S. Walley; Pt. Pelee, June 6, 1929, G. S. Walley; Ventnor, Aug. 1, 1928, J. A. Adams.

MANITOBA: Aweme, July 6, 1922, N. Criddle; Treesbank, Aug. 15, 1922, N. Criddle.

ALBERTA: Lethbridge, May 8-13, 1920, J. H. Pepper.

BRITISH COLUMBIA: Peachland, Oct. 7, 1931, A. N. Gartell; Wellington; Victoria, June 6, 1923, K. F. Auden; Chilliwack, Sept. 20, 1925 (Univ. of Kans.); Mt. Cheam, Sept. 13, 1924 (Univ. of Kansas); Van Couver Island, Saanich Dist., Sept. 1, 1917, W. D. (Rept. by Parshley, 1919) Oliver; Aug. 6, 1931, L. D. Anderson (Univ. of Kansas).

All above Canadian records from material in Ottawa, Canada, unless otherwise stated.

UNITED STATES

MAINE: Orono, May 8 to Oct. 17 (see H. M. Parshley).

MASSACHUSETTS: Amherst, May 16, 1922.

RHODE ISLAND: Providence (Bueno Coll.).

CONNECTICUT: Apr. 9 to Oct. 24 (see Conn. Geol. and Nat. Hist. Surv. Bull. 34).

NEW YORK: Long Island, May; Ithaca, Nov. 19, 1921, P. W. Claassen.

NEW JERSEY: Rancocas, Aug. 29, 1927, E. M. Becton.

PENNSYLVANIA: Rockville, Apr. 1, 1917, J. G. Sanders (C. J. Drake).

VIRGINIA: Warrenton, June 7, 1928, L. Woodruff.

KENTUCKY: Pond near Brooklyn Bridge, Jan. 3, 1933, H. Garman (taken along with *N. indica* Linn.).

OHIO: Columbus, Oct. 2, 1914, C. J. Drake; Zanesville, Aug. 10, 1915, C. J. Drake.

MICHIGAN: Cheboygan Co., July 12 and 31, H. B. Hungerford; Mackinac Island, Aug. 19, 1925, H. B. Hungerford; Nigger Creek, Mullett L., Aug. 4, 1925, H. B. Hungerford; Bois Blanc Island, Aug. 14, 1932, H. B. Hungerford.

Many other collections near Douglas L., Cheboygan Co., by H. B. Hungerford, covering ten summers.

INDIANA: Kosciusko Co., July, 1932, G. E. Gould (Purdue Univ.).

ILLINOIS: Normal, June 22, 1883; Towanda Pond, April, 1882; Havana, July 7, 1910, and many other records in Illinois Nat. Hist. Surv. Mus.

WISCONSIN: Lone Rock, Aug. 14, 1906.

MINNESOTA: Bengal, Aug. 18, 1922, H. B. Hungerford; Becker Co., Aug. 22, 1922, H. B. Hungerford; Beaver Dam, Minn., Aug. 12, 1922, H. B. Hungerford; Itasca Park, Aug. 21, 1922. H. B. Hungerford.

IOWA: Ames, Oct. 11, 1924, H. M. Harris.

MISSOURI: Kansas City, F. Rogers; St. Louis, April, 1900, J. Abbott; Columbia, Nov. 24, 1911, J. F. Abbott.

ARKANSAS: Arkansas Co., Oct. 6, 1930, D. Isely; Fayetteville, Nov. 14, 1929, D. Isely.

TEXAS: Sutton Co., Aug. 20, 1928, A. M. James; Eastland Co., Jan. 2, 1921, Grace Wiley; Randall Co., July 7, 1927, R. H. Beamer; Valentine, Aug. 13, 1927, R. H. Beamer; Presidio Co., July 16, 1927, R. H. Beamer.

OKLAHOMA: Ardmore, April 14, 1923, H. B. Hungerford; Grant Co., Feb. 20, 1921, W. E. Hoffmann.

KANSAS: Doniphan Co., Aug. 27, 1921, W. J. Brown; Leavenworth Co., Feb. 6, 1921, W. E. Hoffmann; Douglas Co. (every month of the year); Riley Co., Oct. 1920, H. B. Hungerford; Allen Co., Apr. 24, 1921, W. E. Hoffmann; Woodson Co., Feb. 24, 1921, W. E. Hoffmann; Cowley Co., Mar. 16, 1921, W. E. Hoffmann; Lyons Co., June 18, 1923, Herbert Darby; Linn Co., 1915, R. H. Beamer; Comanche Co., June 19, 1927, H. B. Hungerford; Meade Co., (no data); Morton Co., Aug. 4, 1924, C. O. Bare; Scott Co., June 22, 1929, Howard Deay; Cheyenne Co., summer, F. X. Williams.

SOUTH DAKOTA: Sand Hills, Martin, Sept. 15, 1930, H. C. Severin; Brookings, June 4, 1928, H. C. Severin; Springfield, June 15, 1928, L. Hendricks, July 12, 1922, H. C. Severin (S. D. St. College.)

MONTANA: Three Forks, July 22, 1931, L. D. Anderson.

IDAHO: Caldwell, May 9, 1926, C. J. Drake.

COLORADO: Estes Park, Aug. 22, 1919, H. B. Hungerford; Pingree Park, Aug. 21, 1926, R. H. Beamer; Las Animas Co., Aug. 22, 1927, P. A. Readio; Lamar, Aug. 22, 1927, P. A. Readio; La Junta, Aug. 22, 1927, L. D. Anderson; Boulder, June 28, 1931, L. D. Anderson; Caisson, July 1, 1931, L. D. Anderson; Ft. Collins, Aug. 19, 1898.

UTAH: Farwest, Sept. 12, 1921, C. J. D. Brown; Emery Co., Aug. 26, 1921, Grace Wiley; Antelope, July 1, 1931, L. D. Anderson.

NEW MEXICO: Socarro Co., Aug. 18, 1927, L. D. Anderson; Torrance Co., Sept. 10, 1925, C. H. Martin; Santa Cruz Co., Aug. 20, 1927, R. H. Beamer; Estancia, Sept. 6, 1925, C. H. Martin.

ARIZONA: Gila Co., Aug. 6, 1927, P. A. Readio; Navajo Co., Aug. 15, 1927, P. A. Readio; Cochise Co., July 29, 1927, R. H. Beamer; Coconini Co., Aug. 13, 1927, P. A. Readio.

CALIFORNIA: Calipatria, July 14, 1923.

NEVADA: Carson City, Aug. 9, 1929, R. H. Beamer.

OREGON: Hot Lake, July 13, 1931, L. D. Anderson; Corvallis, June 26, 1926, C. J. Drake.

WASHINGTON: Kalama R., July 21, 1931, L. D. Anderson; Takoma (Hamburg, Germany).

I lack material from the following states: Maryland, District of Columbia, West Virginia, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Nebraska, North Dakota, Wyoming.

MEXICO

San Antonio, July 15, 1927, L. D. Anderson.

Notes on *Notonecta punctata* Fieber, 1851

Doctor Fieber described this from Baltimore, North America. Without doubt it is *N. undulata* Say and Kirkaldy was correct in so considering it. Fieber does not mention the museum where the insects belong. There are in the Zoölogical Museum in Berlin 4 specimens under the name *N. punctata* Fieber. They are labeled as follows:

First. "3624" "Mexico Deppe" "punctata Fieb." (This is near *N. shooteri* Uhl. Fieber's type was from Baltimore.)

Second. Label like the first but lacking determination label.

Third. "Cat. N. 3624" "Mexico, Deppe." This is not *N. shooteri*, a smaller species with rounded trochanter.

Fourth. "7195" "Mexico." This is near *N. shooteri* Uhler.

All of the above coming from Mexico cannot be Fieber's types.

Notonecta indicoidea Hungerford, 1927

(Color Plate II, fig. 2; Plate XIV, fig. 8)

1927. *N. indicoidea* Hungerford, Bull. Brookl. Ento. Soc. XXII, p. 250.

Referring to this species, also:

1897. *N. undulata* var. *charon* Kirkaldy. Trans. Ento. Soc. London, p. 411 (in part). In Stockholm Mus. lab. by Kirkaldy.

1897. *N. shooterii* Kirk. Trans. Ento. Soc. London, p. 408 ("Two handsome Notonectæ from Guanajuata in Mex. Dugés in Mus. Paris").

Size. Length, 10.8 mm. to 11 mm.; width of pronotum, 3.9 mm.

Color. General facies dark. Head, anterior half of pronotum and limbs yellow. Rear half of pronotum darkened by the black mesonotum beneath. Scutellum black. Hemelytra black, save two oblique tan streaks near base of corium and clavus and tip of membrane, which is pale. Venter black except connexivum and a spot on median line of fourth and fifth abdominal sternites.

Structural Characteristics. Head and eyes not prominent; anterior outline of head rather flattened; vertex subequal to shorter than its anterior width; anterior margin of vertex less convex than margin of the eye; anterior margin of vertex longer than frontal margin of an eye. Anterior breadth of vertex : synthlipsis :: 12:5. Pronotum a trifle less than twice the length of the head; lateral margins faintly convex and explanate; anterolateral angles slightly embracing the eyes; lateral ledge, as seen from the side, straight, slightly turned down in front and not as long as the rear margin of the eye beneath. Scutellum longer than either pronotum or ridge of hemelytral commissure. Posterior lobe of membrane slightly shorter than anterior lobe. Anterior trochanter of male with minute hook. Mesotrochanter rounded. Male genital capsule as shown on Plate XIV.

Location of Type. In Francis Huntington Snow Entomological Museum, University of Kansas.

Comparative Notes. Distinguished from *N. indica* Linn. by wider synthlipsis and from *N. unifasciata* Guér. by the black scutellum.

Data on Distribution. Known to me only from Mexico, D. F.

Notonecta distinctoidea Hungerford, 1930

(Color Plate II, fig. 6; Plate XIII, fig. 9)

1930. *N. distinctoidea* Hungerford. Bull. Brook. Ento. Soc. XXV, p. 141.

Size. Length, 10.8 mm. to 12 mm.; width of pronotum, 4 mm. to 4.3 mm.

Color. General facies dark. Head, anterior part of pronotum and legs pale yellow to horn. Face, legs and lateral margin of abdominal venter more or less tinged with green. Scutellum black. Hemelytra purplish-black save two short, oblique tan streaks near base of corium and clavus, and tip of membrane, which is pale.

Structural Characteristics. Anterior outline of head viewed from above convex; vertex shorter than its anterior width; margin of vertex less convex than the margin of an eye; anterior breadth of vertex : synthlipsis :: 13:6. Inner margins of the eyes straight and divergent. Pronotum declivant, not quite twice length of head; lateral margins straight and divergent; anterolateral angles slightly embracing the eyes; lateral ledge, as seen from the side, straight and not as long as rear margin of the eye beneath, oblique. Scutellum longer than the pronotum. Hemelytral commissure shorter than scutellum. Posterior lobe of membrane slightly shorter than anterior lobe. Anterior trochanter of male with a very small hook. Mesotrochanters rounded. Penultimate abdominal sternite of female very slightly notched and last one not notched at tip. First pair of gonapophyses of female short. Male genital capsule as shown on Plate XIII.

Location of Type. Holotype in Paris Museum. This species was described from three males labeled as follows: "Mexique," Coll. Noualhier 1898"; Mexique, Etat de Jalisco, L. Diguet 1900"; Mexico, W. H. Ashm. determined *N. americana* Fab. var. by Kirkaldy '97."

Comparative Notes. See notes under *N. melaena* Kirk. In comparing this species with *N. indicoidea* Hungerford it may be noted that the species is plumper of body (more like *N. melaena* Kirk.) and differs in shape of male genitalia.

Data on Distribution. Known only from type localities.

KEY TO NOTONECTA OF SOUTH AMERICA

1. Keel of fourth abdominal sternite bare, the hairs confined to the sides. . *N. mexicana.**
(Colombia, p. 75.)
Keel of fourth abdominal sternite not bare.................... (2)
2. Last abdominal sternite of female large and strongly constricted just before the tip, male with digitate prolongation on genital capsule................ *N. nigra.*
(Brazil?, p. 126.)
Last abdominal sternite of female normal, male without digitate prolongation on genital capsule.................... (3)
3. Pronotum broad in front embracing the eyes, which are flattened, and receding from anterior margin of vertex. Synthlipsis broad, one-half anterior margin of vertex as seen from above. Scutellum plainly broader than long. Male with stout tubercle at angle of front trochanter and a very stout, broad hook as shown on Plate IX, fig. 4.................... (4)
Pronotum and eyes not as above. Scutellum not plainly transverse. Males without stout tubercle at angle of front trochanter and with small hook on its anterior surface.................... (5)
4. Length usually under 12 mm.................... *N. ochrothoe.*
(Colombia, p. 99.)
Length usually more than 12 mm.................... *N. colombiana.*
(Colombia, p. 128.)
5. Mesotrochanter more or less angulate.................... (6)
Mesotrochanter rounded.................... (8)
6. Mesotrochanter distinctly angulate.................... *N. unifasciata angulata.*
("S. Amer.," p. 111.)
Mesotrochanter feebly angulate.................... (7)
7. Length less than 10 mm.................... *N. bifasciata.*
(Argentina, p. 129.)
Length more than 10 mm.................... *N. confusa.*
("S. Amer.," p. 130.)
8. Length usually less than 10 mm.................... (9)
Length usually more than 10 mm.................... (17)
9. Typical facies dark.................... (10)
Typical facies distinctly black and white.................... (14)
10. Facies nearly black. Spots on end of corium not conspicuous.................... (11)
Facies dark but with spots on end of corium distinct or clavus pale.................... (12)
11. Synthlipsis less than one-third width of an eye. Size small.
(Max. length, 9 mm.).................... *N. pulchra.*
(Paraguay, p. 131.)
Synthlipsis more than one-third width of an eye. Size larger.
(Min. length, 9 mm.).................... *N. polystolisma.*
(Brazil, p. 132.)
12. Synthlipsis : width of eye behind : : 5.3 : 9.................... *N. peruviana.*
(Peru, p. 134.)

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* Other members of this group are keyed out in Key to North and Central America, which see if description does not fit.

Synthlipsis : width of eye behind : : 4 : 9 (about)........................ (13)

13. Synthlipsis : width of eye behind : : 4.1 : 9. (See drawing of male clasper, page 155) ....*N. virescens.*
(Chile, p. 135.)

Synthlipsis : width of eye behind : : 3.9 : 9. (See drawing of male clasper, Plate XII, fig. 3..*N. bicircoidea.*
(Argentina, p. 136.)

14. Hemelytra, viewed from above with two large nearly circular pale spots in the transverse black band. Vertex to synthlipsis : : 5 : 2..............*N. bircirca.*
(Chile, p. 137.)

Hemelytra, viewed from above, with small or transverse tan or pale spots in the transverse black band. Vertex to synthlipsis at least as 3 : 1.................. (15)

15. Vertex to synthlipsis near 3 : 1.. (16)

Vertex to synthlipsis near 4 : 1..*N. minuta.*
(Bolivia, p. 138.)

16. Clasper of male genital capsule broad and bifurcate. (See Plate XII, fig. 4) ....*N. sellata.*
(Argentina, p. 139.)

Clasper of male genital capsule not as above. (See Plate XII, fig. 7)..*N. disturbata.*
(Brazil and Paraguay, p. 140.)

17. Color black and white..*N. variabilis.**
(Brazil, p. 141.)
And *N. indica.*
(Colombia, p. 113.)

Color not black and white.. (18)

18. Synthlipsis less than three-fifths of width of eye behind..................*N. fazi.*
(Chile, p. 142.)

Synthlipsis more than three-fifths of width of eye behind.....*N. vereertbruggheni.*
(Argentina, p. 144.)

Notonecta nigra Fieber, 1851

(Color Plate I, fig. 15; Plate XVI, fig. 3)

1851. *N. nigra* Fieber. Rhynchotographieen, p. 473.
1897. *N. nigra* Fieber. Kirkaldy, Trans. Ento. Soc. London for 1897, p. 424.
1904. *N. nigra* Fieber. Kirkaldy, Wien, Ento. Zeit. xxiii, p. 132.
1909. *N. nigra* Fieber. Kirkaldy and Bueno, Proc. Ento. Soc. Wash. x, p. 199.

Size. Length, 16 mm.;† width of thorax 5.5 mm. (female). The male is smaller, being 4.8 mm. across thorax.

Color. Chocolate brown to nearly black. Pronotum, head and limbs shining and also chocolate brown to nearly black. Scutellum and venter black.

Structural Characteristics. As in *N. glauca* L. (See p. 48.)

Location of Types. Three specimens, two females and one male, in Vienna Museum, and one specimen, a female, in Paris Museum.

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* See discussion under these two species.

† NOTES ON FIEBER'S MEASUREMENTS: Doctor Fieber gave the length of his Notonecta species in "linien." Since several different units called lines have been employed, I wrote to my friend, Doctor Walther Horn, concerning the problem. With his usual kindness he promptly informed me that: "We have had in the past time in Europe almost as many different kinds of 'linien' as small states. Sometimes a 'linie' was one-tenth, sometimes one-twelfth of an inch. In the following I give you three kinds: Paris 'linie,' 2.2558 mm.; Rheinprovinz linie, 2.179 mm.; English line, 2.116 mm. There have been many other kinds. For example, there is before me a measuring instrument where 12 "linien" = 27 cm." Fortunately, I have studied Fieber's *N. nigra* types in the Vienna museum. They measure 16 mm. in length. Since Doctor Fieber gives "7⅓ linien" as the length of this species, it is easy to figure that he employed the Rheinprovinz linie, which equals 2.179 mm.

One of the Vienna females lacks distal half of abdomen, and the male has lost the hind legs and the tibia of one front leg. The Vienna specimens are labeled "Brasilien" and the Paris specimen "Brèsil." I have compared the labels side by side; the paper is the same in texture and of the same width. The "Brazilien" label is longer. The handwriting and the ink look identically the same to me. The pins are, however, quite different, but both specimens show that they have been repinned. The Paris specimen bears also the label "Museum Paris, Coll. Noualhier 1898." It is even nearer black than the Vienna specimens and is labeled "type." I would give it cotype standing, and have labeled the Vienna specimens with red cotype labels. Fieber wrote "Aus Brasilien (kais. kön Hofnat. Cabinet in Wien; gesammelt von Schott).

Comparative Notes. This species is a puzzle to me. I can find no structural characteristics to distinguish it from *N. glauca* Linn. of Europe. The genital capsules of the males are alike and the female genitalia are alike. The specimens of *N. nigra* Fieb. are larger than the average *N glauca* Linn. and have a little different shape. The unusual color of *N. nigra* Fieb. certainly gives it a different facies. At times I have been convinced that these four specimens might be only stained specimens of *N. glauca* Linn., labeled "Brèsil" and "Brasilien" by some unscrupulous dealer. I have seen Notonecta collected from acrid coffee-colored waters of some bogland pool that were nearly as dark as *N. nigra* Fieb. For example, in the Museum of Paris there is a series of specimens labeled "Takersan," "Museum Paris, Algérie, P. Lesne 6-97," determined as *N. glauca* by Kirkaldy and more recently *N. maculata*." One of these has the venter covered with bits of wood fiber, as if taken in a pool of coffee-colored water, and is nearly as black as the cotypes in Vienna. There are other specimens that have the black legs and are but slightly lighter in color, and still others that are of typical *N. maculata* color. Even the darkest specimens of this series, however, have the orange band on the abdominal dorsum. I recall also a female specimen labeled "Soeul, Korea," in the Hungarian Museum at Budapest. This specimen is light chocolate in color. The venter is covered with bits of wood, as if the specimen had been collected in amber-colored bog waters. The scutellum is black; the anterior margin of hemelytra shows faintly the darker maculations that are so characteristic of *N. glauca* Linn. Compared with *N. canariensis* Kirkaldy, *N. nigra* Fieb. is a more slender species; the head is smaller and the limbs very plainly more slender. Compared with

N. v. viridis Delcourt, it does not have the anterior lateral angles of the pronotum embracing the eyes, and has longer and more slender front and middle legs.

There will continue to be some doubt in my mind about the authenticity of the label "Brazil" until some further evidence is available. I have many South American Notonecta from various places in Brazil, but no species even akin to this *N. nigra* Fieber have been taken in South America in modern times.

In the museum at Oxford, England, there are two insects (a male and a female) that look like *N. obliqua* Gallén and bear a tiny green square and a label, "Miers coll.; Presented 1880 by J. W. Miers." Professor Poulton says most, if not all, of Miers' insects came from South America.

While there is still much uncertainty about *N. nigra* Fieber, I do not wish to take the responsibility of denying the existence of this species in South America, and am sure that if further material becomes available it will be possible to find in a longer series the proper position of this species. Every South American collector should be on the alert for this species.

Notonecta colombiana new species.

Size. Length, 12 mm. to 12.6 mm.; width of pronotum, 4.5 mm.

Color. No doubt a bichromatic species, but only the dark form known to me. The scutellum is black. The hemelytra are brown and black with a luteous streak along the claval suture and a luteous transverse spot at end of basal third of corium. Lower half of propleuræ, prosternum, mesoternum and spots on abdominal venter black. Face, limbs and connexivum may be yellowish or suffused with green.

Structural Characteristics. Anterior outline of head viewed from above quite convex; vertex longer or subequal to its anterior width; margin of vertex more convex than margin of the eye; anterior breadth of vertex : synthlipsis : : 17:12. Pronotum steeply declivant as viewed from the side. Pronotum twice length of the head; lateral margins somewhat divergent and straight; anterior angles acute and embracing the eyes; lateral ledge as seen from the side nearly straight, as long as the rear margin of the eye below it, and nearly horizontal. Scutellum about as long as pronotum. Anterior lobe of membrane a little longer than posterior lobe. Anterior trochanter of male with the stout hook and protuberance characteristic of the *N. shooteri* group. Male genital capsule much as in *N. melaena* Kirk.

Location of Type. Holotype, allotype and two paratypes in the Zoölogical Museum at Berlin; two paratypes in Francis Huntington Snow Entomological Museum of University of Kansas. The above labeled "Bogata 8000?, Kalte Region, Bobisch L." Hamburg Museum has two paratypes labeled "Bogata, Dr. O. Bürger leg. III, 1897, Vend. 1, I, 1898." In the Vienna Museum there is one labeled "Bogata, Coll. Signoret," and is marked "*N. rugosa* Fieb."

Comparative Notes. Mistaken for *N. shooteri* Uhler, from which they differ by the shape of male genital capsule, by the straighter margins of the pronotum and more declivant pronotum. It is a larger species than *N. melaena* Kirkaldy, with more rounded head and luteous stripe on claval commissure.

Data on Distribution: Colombia, South America: Bogata 8000′, Bobisch L. (Berlin Mus.); Bogata, Dr. O. Bürger, leg. III, 1897. Vend. 1, I, 1898, Hamburg Mus.; Bogata coll. Signoret (labeled *rugosa* Fieb.).

Notonecta bifasciata Guérin, 1844

(Plate XII, fig. 1)

1844. *N. bifasciata* Guérin-Méneville. Icon. du Regne Anim. Ins., III, p. 354.

1851. *N. bifasciata* Guérin. Fieber, Rhynchotgraphieen (Abh. Böhm. Ges. Wissensch. Prag V, 7, p. 480). (Known to Fieber only by desc.)

1853. *N. bifasciata* Guérin. Herrich-Schäffer, Die Wanzenartigen Insecten IX, p. 136 (in Index).

1879. *N. bifasciata* Guérin. Berg, Hemiptera Argentina . . ., p. 197 of reprint. (Under *N. variabilis* Fieb. in error.)

1897. *N. bifasciata* Guérin. Kirkaldy, Trans. Ento. Soc. London, 1897, p. 413. (Kirkaldy saw the type.)

1899. *N. bifasciata* Guérin. Kirkaldy, Boll. Mus. Torino, xiv, No. 347, p. 2. (Only in part.)

1904. *N. bifasciata* Guérin. Kirkaldy, Wien, Ento. Zeit. xxiii, pp. 95-132. (Kirkaldy thought only a var. of *N. undulata* Say, but was in error.)

1909. *N. bifasciata* Guérin. Kirkaldy and Bueno. Catalogue . . .Proc. Ento. Soc. Washington. x, p. 198. (Only in part.)

1926. *N. bifasciata* Guérin. Hungerford, Psyche xxxiii, pp. 12 and 15. (My error; not this species.)

1930. *N. bifasciata* Guérin. Hungerford, Bull. Brooklyn Ento. Soc., xxv, p. 140. (Corrects error of 1926.)

Size. Given by Guérin as 8.5 mm. long and 3 mm. wide. According to my measure, the type is 9.3 mm. long.

Color. I have seen the type, which is a male, and give the following descriptive information: The general facies dark, the scutellum black; hemelytra dark except a pale stripe on basal two-thirds of clavus, the inner margin against the scutellum being brown throughout; against the clavocorial suture there is a triangular pale patch on the corium; at distal end of embolium (on the suture) there is a transverse orange spot and above it a larger one irregular in shape;

tip of membrane pale, hemelytra (the dark part particularly) covered with silvery, narrowly spatulate hairs.

Structural Characteristics. Anterior margin of vertex : synthlipsis :: 11:4; the width of an eye at its base equals the width of the anterior margin of the vertex. The anterior trochanter of the male has the little hook, as in other small South American species, such as *N. bicirca* Hungerford, for example. The mesotrochanter is not angulate, but not rounded as in some other species. The male genital capsule is shown on Plate XII, figure 1.

Location of Type. There is a specimen in the Paris Museum labeled "type," and from the top down the labels read: 1st, "Type"; 2d, "Museum Paris, Maldonado Coll. Guér.-Menev. ex coll. A. Sálle 1897" (printed); 3d, "Notonecta bifasciata Guér. Ic. R. A. Platta (type) Maldonade" (written); 4th, "Notonecta polystolisma Fieb., p. 53, Maldonado bifasciata Guér. Ic. R. A. (type)"; 5th, "*Notonecta bifasciata* Guér. det Kirkaldy 1897." Kirkaldy quotes these on page 413 of his "Revision." The type is a male and appears to have been broken into two or three parts and glued together. One hemelytron is in two pieces and glued to the side of the body, and the pronotum sometime has been parted from the after body.

Comparative Notes. I was surprised to find that this is not the species I named *N. bifasciata* in my paper of 1926, where I figured the genital capsule of what I thought to be Guérin's species. The type has a male clasper more like my *N. pulchra,* but it is not the same species. *N. pulchra* Hungerford is a smaller species with longer head and narrower synthlipsis. On the other hand, it is a smaller species than my *N. bicirca* or *N. bicircoidea.* Of course, it is not what I named *N. polystolisma* var. *spatulata.* While the shape of the male genital capsule resembles somewhat my *N. disturbata,* a comparison of the species side by side shows them to be distinct. *N. disturbata* Hungerford has a longer head and a narrower synthlipsis. Indeed, it proved to be a species I had never seen.

Data on Distribution. Known to me only by the type. I cannot accept the distribution records of former workers, who most obviously have confused the species. Maldonado is in Uruguay, S. A.

Notonecta confusa Hungerford, 1930

(Color Plate II, fig. 4; Plate XIII, fig. 7)

1930. *N. confusa* Hungerford. Bull. Brooklyn Ento. Soc., xxv, p. 140.

Referring to this species, also:

1926. *N. species?* Hungerford. Psyche, xxxiii, pl. 2, fig. 6.

Size. Length, 12 mm.; width of thorax, 4 mm.

Color. The color of the solitary type specimen is pale yellow throughout. The typical color is probably black and white as in *N. undulata* Say.

Structural Characteristics. Size and general appearance might confuse this species with *N. undulata* Say, from which it differs in having the mesotrochanter feebly angulate and the male genital clasper with broader branches, as shown on Plate XIII.

Location of Type. Described from a single male specimen from "S. Amer." type in the P. R. Uhler collection in the U. S. National Museum, Washington, D. C.

Comparative Notes. Until a series of specimens, including both sexes, is found, it is impossible to offer any further comparisons.

Data on Distribution. Beside the type, I have a specimen labeled "Cuba" which belongs to this species.

Notonecta pulchra Hungerford, 1926

(Color Plate I, fig. 10; Plate XII, fig. 8)

1926. *N. pulchra* Hungerford. Psyche XXXIII, p. 14, Pl. II, fig. 3.

Size. Length, 7.5 mm. to 9 mm.; width of pronotum, 2.18 mm. to 3.1 mm.

Color. General facies dark. Scutellum entirely black or marked with a tan spot on each lateral margin. Hemelytra black save two pale spots at base of hemelytra and an orange irregular transverse band at end of corium. Silvery hairs on hemelytra. When typically colored, a beautiful little species.

Structural Characteristics. Anterior outline of head viewed from above nearly flattened; vertex as long as anterior width; margin of vertex less convex than anterior margin of an eye; anterior breadth of vertex : synthlipsis :: 11:3; synthlipsis less than one-third the rear margin of an eye. Pronotum less than one and one-half times as long as head; lateral margins straight and quite divergent; antero-lateral angles not embracing the eyes; lateral ledge, as seen from the side, curved, oblique and shorter than rear margin of eye beneath. Scutellum a little longer than pronotum. Membranal lobes about equal. Anterior trochanter of male with hook. Mesotrochanter rounded. Penultimate abdominal sternite of female notched. Last one not elongate, notched at tip. Male genital capsule as shown on Plate XII.

Location of Types. Holotype, allotype and some paratypes in Francis Huntington Snow Entomological Museum, others in U. S. N. M. at Washington, D. C.

Comparative Notes. The typical color of this species sets it apart from the others of its size. The plump capsule of the male with its broader clasper separates it from *N. disturbata* Hungerford and *N. bifasciata* Guérin.

Data on Distribution. Paraguay: Villarica, Dec. 16, 1927, F. Schade; Villarica, Estero Granda, Nov. 1, 1924, F. Schade; Villarica, Sept. 16, 1923, F. Schade; Villarica, March 26, 1924, F. Schade; Caraveni, L. Montis, Oct. 30, 1924, F. Schade; Villarica, Jan. 19, 1926, F. Schade.

Notonecta polystolisma Fieber, 1851

(Color Plate I, fig. 11; Pl. XII, fig. 2)

1851. *N. polystolisma* Fieber. Rhynchotographieen, pp. 477-478.
1926. *N. polystolisma* Fieber. Hungerford, Psyche xxxiii, p. 12.
1928. *N. polystolisma* Fieber. Jaczewski, Annales Musei Zoölogici Polonici vii, p. 121.

Referring to this species, also:

1851. *N. polystolisma* var. *guttata* Fieber. Rhynchotographieen, p. 478.
1851. *N. polystolisma* var. *bipunctata* Fieber. Rhynchotographieen, p. 478.
1851. *N. polystolisma* var. *fasciata* Fieber. Rhynchotographieen, p. 478.
1851. *N. polystolisma* var. *immaculata* Fieber. Rhynchotographieen, p. 478.
1897. *N. bifasciata* Kirkaldy. Trans. Ent. Soc. London for 1897, p. 413. (As syn. in error.)
1904. *N. bifasciata* Kirkaldy. Wien. Ent. Zeit., xxiii, p. 132. (As syn. in error.)
1909. *N. bifasciata* Kirkaldy & Bueno. Proc. Ent. Soc. Wash. x, p. 198. (As syn. in error.)
1926. *N. polystolisma* var. *spatulata* Hungerford. Psyche xxxiii, p. 12.

Size. Length, 9 mm. to 9.6 mm.; width of pronotum, 3.1 mm. to 3.45 mm.

Color. General facies dark. Anterior half of pronotum, propleura, head and legs from horn to brownish yellow often tinged with green. Venter brown to black except metaxyphus and connexivum, which are usually colored like the legs. Scutellum black except in teneral specimens. Hemelytra black or blue black with oblique bifurcate tan streak along basal half of claval commissure, and either two spots or transverse band across corium at tip of clavus. Tip of membrane usually pale.

Structural Characteristics. Anterior outline of head, viewed from above, only slightly convex; vertex slightly shorter than anterior width and less convex than anterior margin of the eye; anterior breadth of vertex : synthlipsis :: 3:1 (sometimes 10:3); the synthlipsis much less than half the rear margin of the eye. Pronotum less than one and one-half times as long as the head; lateral margins straight and divergent; anterolateral angles not embracing the eyes; lateral ledge as seen from the side faintly sigmoid and decidedly oblique, shorter than the rear margin of the eye beneath. Scutellum longer than the pronotum. Membranal lobes subequal. Anterior trochanters of male with hook. Mesotrochanters rounded. Penultimate abdominal sternite of female notched, last one rather elongate and roundly notched at tip. Female gonapophyses of moderate length. Last abdominal sternite of male rather large and constricted before the tip. Male genital capsule large and as shown on Plate XII.

Location of Type. Fieber described five varieties under this species, one of which is *N. sellata* and a very distinct species. The other four are from Brazil and appear to be stages of pigmentation of a single species. I named a variety "*spatulata*," but now suppress it, as I consider the dark form as really the usual color of the species. There are no specimens in the Berlin Museum that I can mark with certainty as types. Under the name *Notonecta polystolisma* Fieb. there is a mixed lot of five specimens, three are *N. indica* Linn. and other two labeled "Cat. No. 3631, Brazilien, Sellow" are what I consider correctly named. There are some unnamed Notonecta in Berlin Museum that belong under this name: One pale specimen labeled "3633 Brasil, Sellow," and another "3634 Brasil, Sellow." The latter is a male with pale scutellum and hemelytra. The female "3633" is partly pigmented. It has a dirty brownish to black median area on scutellum with an uneven paler stripe along lateral margins, the clavus and upper part of corium are pale, a thin brown streak on clavus bordering a brown streak between corium and embolium from base to middle of corium where it widens into a patch of brown covering distal half of embolium and corium but not reaching up to claval margin. Some brown on base of membrane. There are some dark forms labeled as follows: "Lages, Brasilien, St. Catharina, Fruhstorfer"; Brasilien, Osten Sacken; Allegrette 3635; 8014 labeled "pallipes, Fabr.," "Brasil Coll. Germ."

Comparative Notes. A little larger than most of the other small typically South America species. The male genital capsule is large and distinctive.

Biological Notes. Doctor Jaczewski, who collected this species in the state of Paraná, Brazil, S. A., found it in ponds and pools in open country and in forests. Some of the pools were formed in the course of small streams. Adults were taken from January to June and nymphs in March, April and June.

Data on Distribution. In addition to the data published by Doctor Jaczewski in Notonectidæ from the state of Paraná, 1928. I can add the following from the collection before me:

BRAZIL: Ypirango, S. Paulo, R. Spitz; Itapuaqueaetuba, Via Poa, EFCB Sao Paulo, E. D. Townsend; Sao Paulo, Aug. 7, 1927, E. D. Townsend (and nymphs); Estado de Sao Paulo, Nov., 1928, E. D. Townsend.

Notonecta peruviana new species

Size. Length, 9.3 mm. to 10.3 mm.; width of prothorax, 3.45 mm.

Color. General facies dark when fully pigmented. Scutellum black. Hemelytra dark with broad oblique streak, tan or horn along base of clavocorial line; oblique orange line on caudal margin of embolium and an obscure orange spot on corium above; membrane mostly brown.

Structural Characteristics. Anterior outline of head somewhat rounded, slightly more convex in female than in male; vertex shorter than its anterior width; margin of vertex less convex than frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 15:8. Vertex a little wider in the females. Synthlipsis : width of the eye behind :: 5.3:9. Pronotum trifle less than twice length of the head; lateral margins straight, moderately divergent; anterolateral angles slightly embracing the eyes; lateral ledge as seen from the side curved and oblique, shorter than rear margin of the eye beneath. Scutellum and pronotum subequal in length. Ridge of hemelytral commissure as long as scutellum. Lobes of membrane of hemelytra equal in length. Anterior trochanter of male rough but hook obscure. Mesotrochanters rounded. Penultimate abdominal sternite of female with deep but narrow notch, last one faintly or not notched. First pair of female gonapophyses short. Male genital capsule as shown on page 155.

Location of Type. Holotype and allotype in Hungarian Museum at Budapest. Paratype in Francis Huntington Snow Entomological Museum, University of Kansas.

Comparative Notes. Separated from *N. virescens* Blanchard and *N. bicircoidea* Hungerford by its wider synthlipsis and by shape of male genital claspers.

Data on Distribution. Known only by the male and two females labeled "Peru, Lauramarca."

Notonecta virescens Blanchard, 1852

(Color Plate II, fig. 11)

1852. *N. virescens* Blanchard, *in* Gay's Chile, Zool., viii, p. 233. Atlas Zoöl. Ins. Hemipt., Pl. II, p. 16.

1863. *N. virescens* Blanchard? Signoret, Revision des Hemipteres du Chile. (Seance du 22 Avril 1863.) (Doubtful—gives length 10 mm.)

1926. *N. virescens* Blanchard. Hungerford, Psyche xxxiii, p. 11.

1930. *N. virescens* Blanchard. Hungerford, Bull. Brooklyn Ent. Soc., xxv, p. 139.

Referring to this species, also:

1897. *N. undulata* var. *virescens* Kirkaldy. Trans. Ent. Soc. London for 1897, p. 411.

1904. *N. undulata* var. *virescens* Kirkaldy. Wien. Ent. Zeit., xxiii, pp. 95 and 132.

1909. *N. undulata* var. *virescens* Kirkaldy and Bueno. Proc. Ent. Soc. Wash., x, p. 199.

Size. Length, 8.7 mm. to 9.3 mm.; width of pronotum, 3 mm. to 3.4 mm.

Color. The type is luteous with hemelytra incompletely marked with brown. The upper pale spot of corium large and not closed, silver, narrowly spatulate hairs on hemelytra. The second specimen is entirely luteous. I have before me three pigmented specimens that must be this species. These have black scutellum with brown stripe on either margin and another before the tip. Clavus is horn except at hemelytral commissure where it is smoky brown, two pale stripes near base of corium separated by smoky, brown streak. Distal half of corium and basal half of membrane black embracing a small tan spot on embolial suture and a large irregular one above it. Colored more like *N. bicircoidea* Hungerford than like *N. bircirca* Hungerford.

Structural Characteristics. Anterior outline of head, viewed from above, somewhat convex; vertex shorter than its anterior width; anterior breadth of vertex : synthlipsis : : 5:2; anterior breadth of vertex a little greater than the rear margin of an eye; the synthlipsis a little more than two-fifths the rear margin of an eye. Pronotum about one and five-sevenths as long as the head; lateral margins in the type less divergent than in *N. bicirca* Hungerford; lateral margins straight; anterolateral angles slightly embracing the eyes; lateral ledge, as seen from the side, curved and shorter than rear margin of the eye beneath. Scutellum a little longer than the pronotum. Membranal lobes subequal. Anterior trochanter of male with hook. Mesotrochanter rounded. Penultimate abdominal segment notched and last one shallowly and roundly notched. Male genital capsule as shown in Text Figure on page 155.

Location of Type. In Paris Museum. The type is a dermestid eaten female, labeled "Museum Paris. Chili, Gay 15 = 43." The head and prothorax are gone. Only one leg left and this is the right middle leg. The hemelytra are incompletely marked with brown as stated above. A second specimen is entirely pale. There are two specimens labeled "Museum Paris, Chili, Coll. G. Fallou 259-95," but this has an angulate trochanter, and the label must be wrong, for this is *N. lunata* Hungerford. There are two other specimens labeled "Museum Paris, Chili, Coll. G. Fallou 259-95" det. *N. virescens* by Fallou and *N. undulata* var. *virescens* by Kirkaldy. These are males.

Comparative Notes. I have compared my own types with this species and find it to be different. The male clasper is more pointed behind than in either *N. bicirca* or *N. bicircoidea.*

Data on Distribution. From Chile, S. A. There are therefore two very closely related little species from Chile and another across the divide in Argentina.

Notonecta bircircoidea Hungerford, 1928

(Color Plate II, fig. 8; Plate XII, fig. 3.)

1928. *N. bircircoidea* Hungerford. Annals Ent. Soc. Am. xxi, p. 120.

Size. Length, 8.8 mm. to 9.6. mm.; width of pronotum, 3.15 mm. to 3.3 mm.

Color. General facies quite like *N. bicirca* Hungerford but darker. The elongate yellow spot on lateral margins of scutellum, which is present in *N. bicirca* is nearly always absent or tan in this species. Hemelytral commissure and tip of clavus black.

Structural Characteristics. The head slightly less prominent than in *N. bicirca* and the anterior margin of vertex a little more rounded; vertex shorter than its anterior width; anterior breadth of vertex : synthlipsis :: 5:1.9. Anterior breadth of vertex greater than rear margin of an eye. Synthlipsis less than half the rear margin of an eye. Pronotum less than twice as long as the head; lateral margins straight, moderately divergent; anterolateral angles nearly normal, slightly embracing the eyes; lateral ledge, as seen from the side, curved, oblique and shorter than rear margin of the eye beneath. Scutellum a little longer than the pronotum. Membranal lobes subequal. Anterior trochanters of male with hook. Mesotrochanters rounded. Penultimate abdominal sternite of female notched, last one broadly and shallowly notched. Male genital capsule as shown on Plate XII. It is relatively larger than in *N. bicirca* Hungerford.

Location of Types. In Francis Huntington Snow Entomological

Museum, University of Kansas. Described from fourteen specimens, four males and ten females, taken by Mr. Vereertbrugghen in Rio Negro Territory, Argentina.

Comparative Notes. Head slightly less prominent than in *N. bircirca,* color pattern difference as shown on Plates I and II. Male capsule relatively larger and clasper broader, with the front and rear curves differently located.

Data on Distribution. Known to me only by the types.

Notonecta bicirca Hungerford

(Color Plate I, fig. 16; Plate XII, fig. 5.)

1926. *N. bicirca* Hungerford. Psyche xxxiii, p. 12, Pl. 2, fig. 1.
1928. *N. bicirca* Hungerford. Ann. Ento. Soc. Amer., xxi, p. 120.

Size. Length, 8.4 mm. to 9.3 mm.; width of pronotum, 3 mm. to 3.3 mm.

Color. General facies spotted, white with scutellum and two circles on hemelytra black. Closer inspection reveals posterior half of pronotum darkened by black thorax beneath, an elongate yellow spot on lateral margins of scutellum; hemelytra yellowish white covered with silvery hairs and with the following typical maculations: Submarginal band of black on base of corium; distal end of clavus black; broad transverse black band traversing distal third of corium and base of membrane and embracing a small orange-yellow spot at end of embolium and entirely surrounding a much larger nearly circular spot above. The general effect produced is that of two black circles surrounding orange-yellow spots upon the insects, the lateral orange-yellow spots upon the margins of hemelytra and opening upon the embolial sutures being unnoticed.

Structural Characteristics. Anterior outline of head slightly convex, more so in male than in female; vertex longer than its anterior width in male, subequal in female; margin of vertex less convex than frontal margin of the eye; anterior breadth of vertex : synthlipsis :: 5:2; anterior breadth of vertex greater than rear margin of an eye; synthlipsis slightly less than twice the rear margin of an eye. Pronotum less than twice as long as the head; lateral margins nearly straight and moderately divergent; anterolateral angles about normal; lateral ledge as seen from the side, curved, oblique and shorter than the rear margin of the eye beneath. Scutellum a little longer than the pronotum. Membranal lobes subequal. Anterior trochanter of male with hook. Mesotrochanters rounded. Penultimate abdominal sternite of female notched and last one broadly and shallowly notched. Female gonapophyses short. Male genital capsule as shown on Plate XII.

Location of Types. In Francis Huntington Snow Entomological Museum, University of Kansas. Some paratypes in U. S. N. Museum, Washington, D. C. Described from 50 specimens from Chile. S. A. Some from Santiago and others from Termas Cauquences. Dec. 15, 1922, by Alfredo Faz.

Comparative Notes. The characteristically spotted appearance of this species is distinctive. While now and then a *N. sellata* Fieb. specimen may have same general color appearance, Fieber's species has narrower synthlipsis and entirely different male clasper. The closest relatives are *N. virescens* Blanchard and *N. bircircoidea* Hungerford. It requires an examination of the claspers of the male to distinguish precisely these three species when the typical coloring is lacking. Both of the latter species are usually more deeply pigmented.

Data on Distribution. Besides the type series I have the following from Chile: Limache, Nov. 12, 14, 15, 1923, A. Faz.

Notonecta minuta Hungerford, 1926

(Color Plate I, fig. 9; Plate XII, fig. 6)

1926. *N. minuta* Hungerford. Psyche xxxiii, p. 14, pl. II, fig. 7.

Size. Length, 7.2 mm.; width of pronotum, 2 mm.

Color. Head, pronotum, legs and basal third of hemelytra yellow. Scutellum and distal two-thirds of hemelytra black with tips of membrane pale. In the broad, black area across the hemelytron are two small, irregular orange spots of nearly equal size. On one of the three specimens there are ill-defined yellowish spots near the base and at the tip of the scutellum.

Structural Characteristics. Anterior outline of head, viewed from above, but slightly convex; vertex longer than its anterior width; margin of vertex less convex than anterior margin of the eye; anterior breadth of vertex : synthlipsis :: 9:2.1; width of eye at base equal to width of vertex; synthlipsis less than a third the rear margin of an eye. Pronotum but little longer than the head; lateral margins divergent and straight; anterolateral angles acute, slightly embracing the eyes; lateral ledge nearly straight, shorter than the rear margin of the eye beneath. Lobes of membrane subequal. Anterior trochanter of male with hook. Mesotrochanters rounded. Male genital capsule as shown on Plate XII.

Location of Types. Described from specimens in the Carnegie

Museum bearing the label "Prov. del Sara Bolivia 450 m. J. Steinbach." One paratype in Francis Huntington Snow Entomological Museum, University of Kansas.

Comparative Notes. The smallest Notonecta known to me.

Data on Distribution. Known only from the types.

Notonecta sellata Fieber, 1851

(Color Plate I, fig. 14: Plate XII, fig. 4.)

1851. *N. Polystolisma* var. *sellata* Fieber. Rhynchotographieen, Böhm Gesell. der Wissensch. Abh. v, 7, p. 478.

1930. *N. sellata* Fieber. Hungerford, Bull. Brooklyn Ento. Soc., xxv, p. 140.

Referring to this species, also:

1861. *N. variabilis* Burmeister. Reise durch die Plata-Staaten I, p. 492 (1861) (probably in part). Says he found it in Montevideo, but not close to Paraná.

1879. *N. polystolisma* Berg. Hemiptera Argentina, p. 198 (reprint from Ann. S. Cient. Argent., viii, p. 75).

1897. *N. variabilis* Kirkaldy. Trans. Ento. Soc. London, 1897, p. 414 (in part).

1904. *N. variabilis* Kirkaldy. Wien. Ento. Zeit, xxiii, p. 95. (Which he considered a var. of *N. undulata* Say, in error).

1909. *N. undulata* Kirkaldy and Bueno. Proc. Ento. Soc. Washington, x, p. 199 (in part).

1926. *N. bifasciata* Hungerford. Psyche, xxxiii, p. 12, plate II, fig. 5.

Size. Length, 8.7 mm. to 9.6 mm.; width of pronotum, 2.8 mm. to 3.2 mm.

Color. Typical color white, with transverse black band across clavus, in which are two tan spots, and with black scutellum margined laterally by short pale stripe. The species may vary from pale to strongly pigmented, as in *N. undulata* Say, for example. Even the darkest forms do not have the scutellum solid black, and all but the teneral forms have abdominal dorsum dark and metathorax black.

Structural Characteristics. Anterior margin of head, viewed from above, only slightly convex; vertex longer than anterior width and less convex than anterior margin of an eye. Anterior breadth of vertex : synthlipsis :: 3:1; the synthlipsis much less than half the rear margin of the eye. Pronotum about one and one-half times as long as head: lateral margins straight in females, slightly concave in males and divergent; anterolateral angles not embracing the eyes; lateral ledge as seen from the side slightly curved, oblique, and shorter than rear margin of eye beneath. Scutellum longer than pronotum. Membranal lobes equal. Anterior trochanters of male with hook. Mesotrochanter rounded. Penultimate abdominal sternite of female notched, last one not elongate, notched at tip. Female gonapophyses (first pair) short. Last abdominal sternite of male normal in size and constricted before the tip. Male genital capsule as shown on Plate XII.

Location of Type. There is a specimen in Berlin Museum labeled "3637 La Platta, Besoke" "Sellata, Germ." This fits description of *N. polystolisma* var. *sellata* Fieber exactly, but bears another label, *N. variabilis* var. *sellata* Germ. If it is not Fieber's type it is certainly Fieber's "*sellata.*" Fieber's type was designated "*Notonecta sellata* Germ. Coll. Buenos Ayres. (Mus. Berol. Hal.) The commonest species about "Buenos Ayres" is this species.

Comparative Notes. The characteristic clasper of the male genital capsule readily separates this species from all other species.

Data on Distribution. I have before me the following:

Argentina: Buenos Aires, Mercides, IV, 12, 1923 R. Hosford; Buenos Aires, Mercides, XI, 19, 1923, R. Hosford; Buenos Aires, Jan. 18, 1904 (U. S. N. M.); Lopez, Mendoza, S. A., C. S. Reed; Alrededores de La Rioja, M. S. Pennington; Buenos Aires, Republique Argentine, J. Künchel 1899, XI, 1897. (Paris Museum); Rep. Argentine Rosario, J. Claine, 1898 (Paris Mus.) Entre Rios. (Paris Mus.); Montevideo, Coll. Noualhier, 1898 (Paris Mus.); Cosquin, Arg. S. A., March 8, 1921, J. C. Bradley (Cornell Univ.); Argentina. S. A. 1925; Argentina, La Granja, Altagracia, Cordoba, 1923, A. Bruch.

Paraguay: Villarica, Loma, Aug. 8, 1924, F. Schade; Molinasque, June, 1928, F. Schade.

Brazil: Alto Paraná, Aug. 29, 1929, F. Schade; Manacapuru, Manaos, Amaz., March. 1928, S. M. Klages.

Bolivia: Dr. A. Barelli (bears two det. labels, 1st "*N. bifasciata* Guer. det. Kirkaldy, 97"; 2d "*N. bifasciata* = polystolisma det. Kirkaldy).

Notonecta disturbata Hungerford, 1926

(Color Plate I, fig. 13; Plate XII, fig. 7.)

1926. *N. disturbata* Hungerford. Psyche, xxxiii, p. 13, Pl. II, fig. 2.

Size. Length, 8 mm. to 8.4 mm.; width of pronotum, 2.8 mm. to 2.9 mm.

Color. From luteous to black and white. The pale ones entirely light, the pigmented ones having a black scutellum with brown stripe on each lateral margin. The hemelytra white with distal end of clavus brownish black and distal half of corium and basal two-thirds of membrane black.

Structural Characteristics. Anterior outline of head somewhat convex; vertex longer than its anterior width; vertex less convex than margin of the eye; anterior breadth of vertex : synthlipsis :: 10:2.7; synthlipsis less than one-third rear margin of an eye, which is equal to or less than width of anterior margin of vertex. Pronotum not more than a third longer than the head; lateral margins straight and divergent, anterolateral angles normal; lateral ledge, as seen from the side, curved, oblique and shorter than rear margin of an eye beneath. Scutellum a little longer than the pronotum. Membranal lobes equal. Anterior trochanter of male with hook. Mesotrochanters rounded. Penultimate abdominal sternite with narrow, deep notch and last one shallowly notched. Male genital capsule as shown on Plate XII.

Location of Type. Sao Paulo Museum, paratype in Francis Huntington Snow Entomological Museum. Three specimens from Campo, Bello Staat, Rio de Janeiro, IV, 1906.

Comparative Notes. The unusual shape of the male genital capsule distinguishes this species.

Data on Distribution. I have before me the following series of this species. Villarica, Paraguay, Dec. 6, 1923, Dec. 15, 1922, Dec. 5, 1923, F. Schade; Natterer, Brasilien (Det. by Kirkaldy as *N. variabilis* Fieb.).

Notonecta variabilis Fieber, 1851

1851. *N. variabilis* Fieber. Rhynchotographieen Abh. böhm Ges. Wiss., v. 7, p. 477.

Referring to this species, also: Fieber described four varieties of this species. Three from Brazil and one from Baltimore. His South American varieties were named *scutellaris, dorsalis* and *unicolor* and were not worthy of varietal names. His *maculata* from Baltimore is another species, now *N. lunata* Hungerford.

Size. Fieber gives the size as 4 4/6 linien, which would be 10.17 mm.

Color. Variable. Some specimens are yellowish-white with face, limbs and connexivum more or less greenish; scutellum in such cases uniformly yellowish-white or more or less suffused with brown. Other specimens may have a broad, black band covering all but the tip of the membrane, across the caudal third of the hemelytra; in such specimens the scutellum may be entirely black, black with lateral margins flavous, or black with from one to three flavous spots—one at the tip and one at the base on either side—or in the case of a single spot, only the tip pale. It is probable that still darker forms occur as in *Notonecta indica* Linn., to which this species is very closely related, if not identical with it.

Structural Characteristics. Almost identical with those of *Notonecta indica* Linn. even to the clasper of the male genital capsule. Fieber says that the front half of the pronotum is finely cross-wrinkled, which character does distinguish these specimens from *N. polystolism* Fieber.

Location of Type. Doctor Kirkaldy could not locate the type. I have examined the collections at Berlin, Vienna and Halle, where Fieber said his specimens were located, and did not find types. In the Berlin Museum there is a pair of specimens labeled "Cat. No. 3632" "Brasilien, Sallow." One of these is a male and resembles *N. indica* Linn. (= *N. howardii* Bueno) in the shape of the clasper of the male, in size and color, rounded mesotrochanter, etc. It has the broad, black vitta across the wings. The scutellum is yellow, except tiny brown spots at base and in the middle. There is a brown line along margin of clavus where it meets the scutellum, a brown streak along front wing margin extending from base of wing to the large black transverse vitta and an indefinite sooty patch on corium. The female has a black scutellum except a yellow spot on each anterior corner and at the tip. It has the broad, black vitta across the hemelytra as in the male. It might well have served for Fieber's description of *N. variabilis* var. *scutellaris*. Since Doctor Fieber said this variety came "Aus Brasilien, Portorico (Mus. Vienn. et Berol.)" and since the above specimens are exceedingly close to, if not identical with, the species common in the islands, I hereby propose to consider these two specimens as plesiotypes of *N. variabilis* Fieber.

Data on Distribution. I have chosen to retain *N. variabilis* Fieb. as a name for the specimens that come from Brazil, in spite of their very close resemblance to the specimens found in Porto Rico which belong to *N. indica* Linn. This I believe to be the safest policy until we find more Brasilian specimens to study or other specimens from intervening territory.

Notonecta fazi Hungerford, 1930

(Color Plate 1, fig. 17; Plate XIII, fig. 2)

1930. *N. fazi* Hungerford. Bull. Brook. Ento. Soc., xxv, pp. 141-142, fig. 1.

Referring to this species, also:

1897. *N. americana* Kirkaldy. Trans. Ento. Soc. London, p. 409, 1897. ("Chili, Valdivia Hamb. Mus.").

1899. *N. undulata* Kirkaldy. Above specimen redetermined by Kirkaldy (not published).

1901. *N. virescens* Reed. Revista Chilena de Historia Natural, v. Reprint "Sinopsis de los Hemipteros de Chile, p. 106.

Size. Length, 12 mm.; width of pronotum, 4 mm. Males a little smaller.

Color. General facies dark. Head, anterior part of pronotum and legs pale yellow. Posterior half of pronotum darkened by the black mesothorax beneath, scutellum black. Hemelytra reddish brown to black marked with tan; the tan markings are variable, typically as follows: on base of clavus and extending as indefinite streak near the outer margin to near its tip; a small area near base of corium sometimes lacking, another of variable form in outer half of corium, sometimes, but not usually, reaching membrane; membrane dark, sometimes with a pale spot on distal half, sometimes with the tip pale instead. Venter dark, except connexivum, metaxyphus and parts of abdominal venter (especially fourth sternite) which are yellowish brown.

Structural Characteristics. Anterior outline of head, as viewed from above, truncate but slightly rounded; vertex slightly shorter than its anterior width in female but longer in the male; anterior margin of vertex less convex and shorter than the eye; anterior breadth of vertex : synthlipsis : : 3 + : 2; synthlipsis less than three-fifths as wide as an eye. Pronotum about twice as long as the head in the female, but sometimes less in the male, due to its relatively longer head; lateral margins not very divergent, straight; anterior angles embracing the eyes; lateral ledge somewhat oblique and shorter than the eye below it. Lobes of membrane about equal. Anterior trochanter of male with a hook. Mesotrochanters rounded. Last abdominal sternite of female notched at tip. Female gonapophyses (first pair) short. Male genital capsule as shown on Plate XIII.

Location of Type. Holotype, allotype and many paratypes in the Francis Huntington Snow Entomological Museum at the University of Kansas. Some paratypes in the U. S. N. M. and in the collection of J. R. de la Torre-Bueno. The types were collected for me by Doctor Alfredo Faz from Limache, Santiago and Termas Cauquenes, Chile.

Comparative Notes. This common Chilean species was known to Doctor Kirkaldy, who called it *N. americana* Fabr. in his 1897 paper and later labeled it *N. undulata* Say. Its short truncate head, general color pattern and male genitalia readily separate it from *N. undulata* Say. Its closest relative is *N. vereertbrugghenl* Hungerford, from which it differs in its narrower vertex, less declivant head, more oblique lateral prothoracic ledge and shape of the male genital claspers.

Data on Distribution. Appears to be widespread in Chile, S. A., and extends north into Peru, S. A.

SOUTH AMERICA

CHILE: Besides those from type localities, I have seen: Valparaiso, R. Martin 1922 (Paris Museum); "Fundort?" (Berlin Museum); Valdivia, Chamelcha "Coll. Breddin" (Deutsches Entomologisches Museum, Berlin-Dahlem).

PERU: "Coll. Breddin" (Deutsches Entomologische Museum, Berlin-Dahlem).

Notonecta vereertbruggheni Hungerford, 1928

(Color Plate II, fig. 3; Plate XIII, fig. 4)

1928. *N. vereertbruggheni* Hungerford. Annals Ento. Soc. Amer., xxi, pp. 119, 120.

1930. *N. vereertbruggheni* Hungerford. Bull. Brooklyn Ento. Soc., xxv, p. 142, fig. 2 (Male genital capsule).

Size. Length, 11 mm. to 12 mm.; width of pronotum, 4.2 mm.

Shape. Normal as viewed from above. From the side the thorax appears more elevated than usual.

Color. General facies dark, typical coloring as follows: Head, anterior half of pronotum and limbs yellow, the last named often somewhat clouded. Posterior half of pronotum darkened by the black mesothorax beneath, scutellum black. Hemelytra black streaked with tan; clavus with longitudinal streak of tan; corium with a longitudinal pale stripe that is often obliterated in the middle, leaving tan spots on base and distal field; membrane black. Venter dark, except connexivum, metaxyphus and parts of abdominal venter (especially fourth sternite) which are yellowish brown.

Structural Characteristics. Head depressed; anterior outline, as viewed from above, rounded; vertex shorter than its anterior width; anterior margin of vertex nearly as convex as and longer than the eye; anterior breadth of vertex : synthlipsis :: 3:2; synthlipsis more than three-fifths as wide as an eye. Pronotum about twice as long as the head; lateral margins not very divergent, straight; anterior angles embracing the eyes; lateral ledge nearly horizontal in front two-thirds, somewhat deflected behind, shorter than rear margin of the eye below it. Lobes of membrane about equal. Anterior trochanter of male with a hook. Mesotrochanter rounded. Last abdominal sternite of female notched at tip. Female gonapophyses (first pair) short. Male genital capsule as shown on Plate XIII.

Location of Type. Francis Huntington Snow Entomological Museum at the University of Kansas. Some paratypes in the U. S. N. M. Described from 15 males and 11 females taken by Mr. Vereertbrugghen, in whose honor the species is named. This series includes the holotype, allotype and paratypes, which were captured in Rio Negro territory of Argentina, South America.

Comparative Notes. This species has the general facies of *N.*

fazi Hungerford from which it differs in the wider interocular space and in the shape of genital claspers of the males.

Data on Distribution. Known only from the type locality.

CHECK LIST OF *NOTONECTA*—LINNÆUS

Subgenus PARANECTA Hutchinson

1. *N. lactitans* Kirkaldy. (Africa.)
2. *N. minuta* Hungerford. (Bolivia, S. A.)
3. *N. peruviana* Hungerford. (Peru, S. A.)
4. *N. disturbata* Hungerford. (Brazil and Paraguay, S. A.)
5. *N. pulchra* Hungerford. (Paraguay, S. A.)
6. *N. bifasciata* Guérin. (Uruguay, S. A.)
7. *N. virescens* Blanchard. (Chile, S. A.)
8. *N. bicirca* Hungerford. (Chile, S. A.)
9. *N. bicircoidea* Hungerford. (Southern Argentina, S. A.)
10. *N. sellata* Fieber. (Argentina, Brazil, Paraguay and Bolivia, S. A.)
11. *N. polystolisma* Fieber. (Brazil, S. A.)
12. *N. vereertbruggheni* Hungerford. (Southern Argentina, S. A.)
13. *N. fazi* Hungerford. (Chile and Peru, S. A.)
14. *N. variabilis* Fieber. (Brazil, S. A.)
15. *N. indica* Linnæus. (South, Central and North America.)
16. *N. confusa* Hungerford. (South America.)
17. *N. undulata* Say. (North America.)
18. *N. distinctoidea* Hungerford. (Mexico.)
19. *N. indicoidea* Hungerford. (Mexico.)
20. *N. raleighi* Bueno. (Southern U. S., America.)
21. *N. lunata* Hungerford. (Northern U. S., America, and Canada.)
22. *N. unifasciata unifasciata* Guérin. (Mexico.)
23. *N. u. cochisiana* Hungerford. (Arizona, U. S. A.)
24. *N. u. angulata* Hungerford. (South America.)
25. *N. u. andersoni* Hungerford. (Western U. S. A. and B. C. Canada.)
26. *N. spinosa* Hungerford. (Northwestern U. S. A. and B. C. Canada.)
27. *N. kiangsis* Kirkaldy. (China and Eastern Siberia.)
28. *N. uhleri* Kirkaldy. (Southeastern U. S. A.)
29. *N. kirkaldyi* Martin. (China.)
30. *N. saramoa* Esaki. (Formosa.)
31. *N. chinensis* Fallou. (China.)
32. *N. immediata* Kiritshenko. (Eastern Siberia.)
33. *N. triguttata* Motschulsky. (Japan.)
34. *N. insulata* Kirby. (Eastern U. S. A. and Canada.)
35. *N. kirbyi* Hungerford. (Western U. S. A. and Canada.)
36. *N. impressa* Fieber. (Mexico.)
37. *N. montezuma* Kirkaldy. (Mexico and Texas, U. S. A.)

Subgenus BICHROMONECTA Hungerford

38. *N. melaena* Kirkaldy. (Mexico.)
39. *N. ochrothoe* Kirkaldy. (Southern California to Colombia, S. A.)

40. *N. colombiana* Hungerford. (Colombia, S. A.)
41. *N. repanda* Hungerford. (Arizona to Mexico.)
42. *N. shooteri* Uhler. (California.)

Subgenus ERYTHRONECTA Hungerford

43. *N. hoffmanni* Hungerford. (California, Arizona and Lower California.)
44. *N. ceres ceres* Kirkaldy. (Costa Rica.)
45. *N. c. stirtoni* Hungerford. (Mexico.)
46. *N. c. rogersi* Hungerford. (Costa Rica.)
47. *N. compacta* Hungerford. (Mexico.)
48. *N. robusta* Hungerford. (Mexico.)
49. *N. mexicana* Amyot and Serville. (Mexico.)
50. *N. m. creaseri* Hungerford. (Mexico.)
51. *N. hintoni* Hungerford. (Mexico.)
52. *N. lobata* Hungerford. (New Mexico, Texas, Mexico.)

Subgenus NOTONECTA Linnæus

53. *N. maculata* Fabricius. (Europe, North Africa east to India.)
54. *N. canariensis* Kirkaldy. (Canary Islands.)
55. *N. pallidula* Poisson. (Algeria and Morocco.)
56. *N. meinertzhageni* Poisson. (Hoggar Mts., Sahara, Africa.)
57. *N. arabiensis* Hungerford. (Arabia.)
58. *N. lutea* Müller. (Northern Europe, Siberia.)
59. *N. borealis* Bueno and Hussey. (Northern North America.)
60. *N. reuteri* Hungerford. (Northern Europe.)
61. *N. viridis viridis* Delcourt. (France and England.)
62. *N. v. mediterranea* Hutchinson. (About Mediterranian and eastward to India.)
63. *N. v. kashmiriana* Hungerford. (Kashmir.)
64. *N. glauca glauca* Linnæus. (Europe.)
65. *N. g. poissoni* Hungerford. (Asia Minor.)
66. *N. g. hybrida* Poisson. (Southern France to North Africa.)
67. *N. g. rufescens* Poisson. (Guernsey Islands.)
68. *N. g. fulva* Fuente. (Iberian Peninsula.)
69. *N. g. kirvillei* Poisson. (Asia Minor.)
70. *N. nigra* Fieber. (Brazil.)
71. *N. obliqua obliqua* Gallen. (Northern and Middle Palearctic.)
72. *N. o. meridionalis* Poisson. (About the Mediterranian.)
73. *N. o. delcourti* Poisson. (Belgium and Northwest France.)
74. *N. amplifica* Kiritshenko. (Southeastern Siberia.)
75. *N. violacea* Kirkaldy. (Burma.)
76. *N. montandoni* Kirkaldy. (China.)
77. *N. irrorata* Uhler. (Eastern North America.)

Subgenus ENITHARONECTA Hungerford

78. *N. handlirschi* Kirkaldy. (Australia.)

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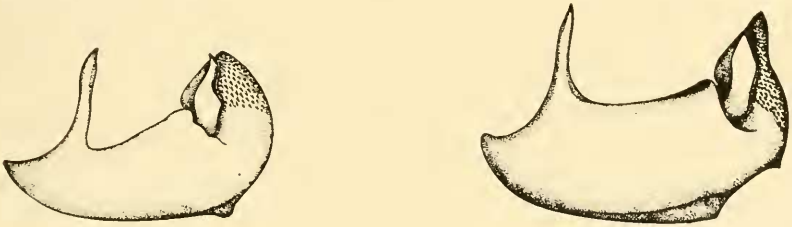

N. virescens. **N. peruviana.**

Text Figure 8. Male genital capsules of *N. virescens* Blanchard and *N. peruviana*, new species. Drawn by Philip Levereault.

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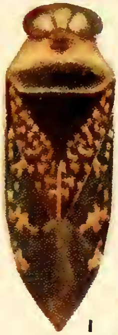
COLOR PLATE I

(Magnification approximately × 3)

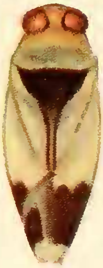
Western Hemisphere Notonecta

Figure

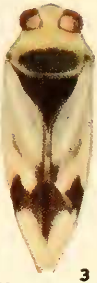
1. *Notonecta irrorata* Uhler. Range: Eastern Canada and eastern half of United States, from Canada to the Gulf and westward to eastern Kansas. (See page 92.)
2. *Notonecta indica* Linn. Range: Across southern United States south of 37° latitude and southward through insular America (Greater Antilles) and through Mexico to Colombia, S. A. (See page 113.)
3. *Notonecta undulata* Say. Range: Across southern Canada and throughout United States from coast to coast and south to northern Mexico. The most common species in the United States. (See page 117.)
4. *Notonecta borealis* Bueno and Hussey. Range: Canada and northernmost states of the United States. Distribution inadequately known, but a Boreal species.. (See page 95.)
5. *Notonecta lunata* Hungerford. Range: Eastern Canada and eastern United States. (See page 107.)
6. *Notonecta shooteri* Uhler. Range: The species (lat. sens.) ranges from California through Arizona to Mexico. The specimen drawn is from Mexico, D. F. (See page 101.)
7. *Notonecta raleighi* Bueno. Range: Southeastern states of United States. (See page 105.)
8. *Notonecta colombiana* Hungerford. Range: Described from Colombia, S. A., previously confused with *N. shooteri* Uhler. (See page 128.)
9. *Notonecta minuta* Hungerford. Range: Described from Prov. del Sara, Bolivia, S. A. (See page 138.)
10. *Notonecta pulchra* Hungerford. Range: This is a very common species in Paraguay, S. A. (See page 131.)
11. *Notonecta polystolisma* Fieber. Range: Common in the region of Sao Paulo, Brazil. (See page 132.)
12. *Notonecta unifasciata* Guérin. Range: (Lat. sens.) From Mexico across western United States to western Canada. (See page 109.)
13. *Notonecta disturbata* Hungerford. Range: Known only from "Brazil," but doubtless region around Sao Paulo. (See page 140.)
14. *Notonecta sellata* Fieber. Range: Argentina, Paraguay and southern Brazil. (See page 139.)
15. *Notonecta nigra* Fieber. Range: Described from Brazil, but doubtful. See discussion under name. (See page 126.)
16. *Notonecta bicirca* Hungerford. Range: Chile, S. A. A common species easily confused with *N. bicircoidea* Hungerford and with *N. virescens* Blanchard. (See page 137.)
17. *Notonecta fazi* Hungerford. Range: Very common in Chile, ranging northward into Peru. (See page 142.)



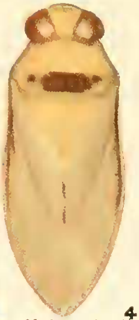
1 *N. irrorata* ♂



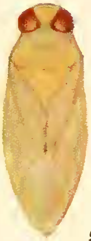
N. indica ♀ 2



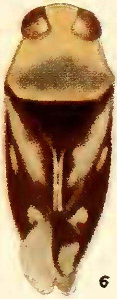
3 *N. undulata* ♀



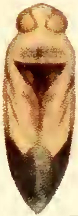
N. borealis ♂ 4



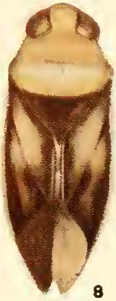
5 *N. lunata* ♀



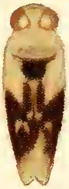
6 *N. shooterii var.* ♂



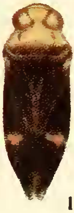
7 *N. raleighi* ♀



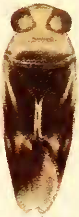
8 *N. colombiana* ♂



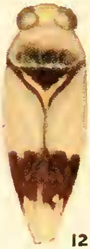
9 *N. minuta* ♂



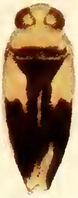
10 *N. pulchra* ♂



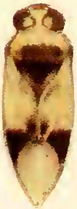
11 *N. polystolisma* ♂



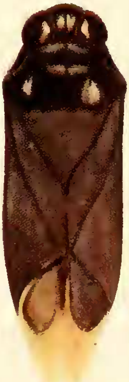
12 *N. unifasciata* ♂



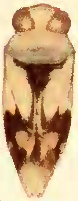
N. disturbata ♂ 13



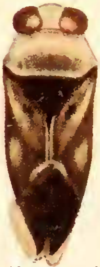
N. sellata ♂ 14



N. nigra ♀ 15



N. bicirca ♂ 16



N. fazi ♂ 17

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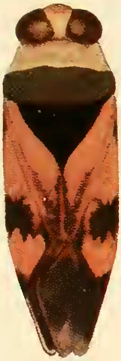
COLOR PLATE II

(Magnification approximately × 3)

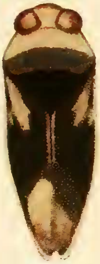
WESTERN HEMISPHERE NOTONECTA

FIGURE

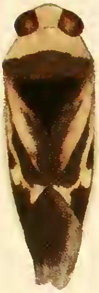
1. *Notonecta montezuma* Kirkaldy. Range: Mexico into Texas, U. S. A (See page 82.)
2. *Notonecta indicoidea* Hungerford. Range: Described from Mexco, D. F. (See page 123.)
3. *Notonecta vereertbruggheni* Hungerford. Range: Described from Rio Negro, territory of Argentina. Compare with *N. fazi* Hungerford on Plate I. (See page 144.)
4. *Notonecta confusa* Hungerford. Range: Known only by the type which was labeled "S. Amer." (See page 130.)
5. *Notonecta borealis* Bueno and Hussey. Range: See Plate I, figure 4, and this plate, figure 10. A study in melanchroism. (See discussion under this species, page 95.)
6. *Notonecta distinctoidea* Hungerford. Range: Known only from Mexico. (See page 124.)
7. *Notonecta spinosa* Hungerford. Range: Described from Utah and now known from Nevada, Montana, Oregon, and British Columbia, Canada. (See page 112.)
8. *Notonecta bicircoidea* Hungerford. Range: Described from Rio Negro, territory of Argentina. Compare with *N. bicirca* Hungerford on Plate I. (See page 136.)
9. *Notonecta indica* Linn. Range: (See Plate I.) This specimen has color of the type specimen, and until carefully studied led to confusion with *Notonecta unifasciata* Guérin. (See Plate I, figure 12, and page 113.)
10. *Notonecta Borealis* Bueno and Hussey. (See figure 5 and page 95.)
11. *Notonecta virescens* Blanchard. Specimen from Paris Museum.
12. *Notonecta rogersi* Hungerford. Now considered by me to be a subspecies of *Notonecta ceres* Kirkaldy. (See page 81.)
13. *Notonecta mexicana creaseri* Hungerford. Range: Known only from type locality in Mexico. (See page 77.)
14. *Notonecta robusta* Hungerford. Range: Type bears no label, but I believe it comes from Chiapas, Mexico. (See page 78.)
15. *Notonecta robusta?* Hungerford. Range: Female specimen from San Cristobal, Chiapas, Mexico, taken by A Dampf, and I believe it to be female of *N. robusta*. (See page 78.)



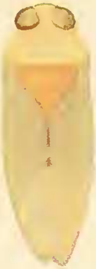
1 *N. montezuma* ♀



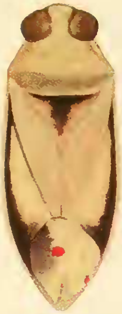
2 *N. indicoidea* ♂



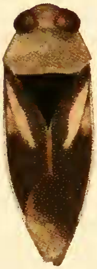
3 *N. vereertbruggheni* ♂



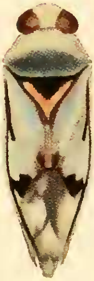
4 *N. confusa* ♂



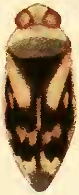
5 *N. borealis* ♂



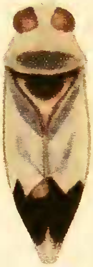
6 *N. distinctoidea* ♂



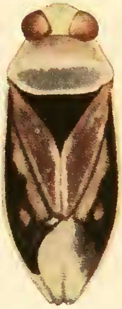
7 *N. spinosa* ♀



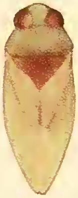
8 *N. bicircoidea* ♀



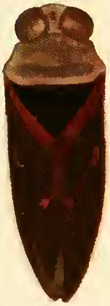
9 *N. indica* ♀



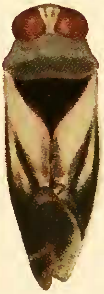
10 *N. borealis* ♂



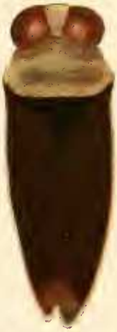
11 *N. virescens* ♀



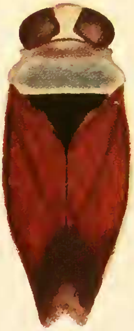
12 *N. rogersi* ♂



13 *N. m. creaseri* ♂



14 *N. robusta* ♂



15 *N. robusta?* ♀

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Kathleen Doering
Delineator

12—3482

COLOR PLATE III

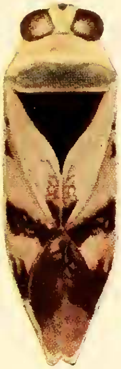
(Magnification approximately × 3)

WESTERN HEMISPHERE NOTONECTA

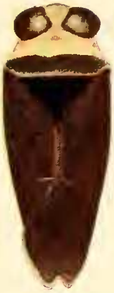
FIGURE

1. *Notonecta insulata* Kirby. Range: Eastern Canada and United States north of fortieth degree of latitude and east of one hundredth meridian. (See page 84.)
2. *Notonecta ceres* Kirkaldy. Range: A common species in Costa Rica. The female shown in figure 3 was named as *N. mexicana* var. *ceres* and the male as *N. mexicana* var. *hades* by Kirkaldy. (See page 79.)
3. *Notonecta ceres* Kirkaldy. (See note above.)
4. *Notonecta kirbyi* Hungerford. Range: Western Canada and Western United States. Hemelytra more often red and black than like the illustration. (See page 88.)
5. *Notonecta lobata* Hungerford. Range: Found in Texas, New Mexico and Arizona. An abundant species in Arizona. Have seen specimens labeled "Mexico." In this species the females are colored as in figures 5 and 10. The males are nearly always darker (see figures 11 and 13.) (See page 70.)
6. *Notonecta compacta* Hungerford. Range: Known from the states of Guerrero and Colima, Mexico. The males are nearly black as in *N. ceres* Kirkaldy and *N. lobata* Hungerford. (See page 73.)
7. *Notonecta melaena* Kirkaldy. Range: States of Jalisco, Guanajuato and Lower California, Mexico. The typical color is darker than the specimen shown. (See page 97.)
8. *Notonecta mexicana* Amyot and Serville. Range: Mexico, but appears to be by no means as common as other species that have been mistaken for it, *N. lobata* Hungerford, for example. (See page 75.)
9. *Notonecta uhleri* Kirkaldy. Range: In United States from Massachusetts south to Mississippi. Its western limit appears to be Illinois and southward, east of Mississippi River. (See page 103.)
10. *Notonecta lobata* Hungerford. (See figure 5.) A typical female. (See page 70.)
11. *Notonecta lobata* Hungerford. A male, showing that the red males are darker than the females. (See page 70.)
12. *Notonecta hoffmanni* Hungerford. Range: California and Arizona in the United States and Lower California in Mexico. (See page 68.)
13. *Notonecta lobata* Hungerford. Range: (See figure 5.) The usual color of the male, and showing its size to be a little larger than the female (see figure 10). (See page 70.)

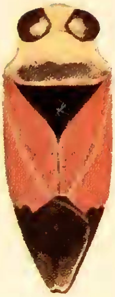
HUNGERFORD—*Notonecta*—PLATE III.



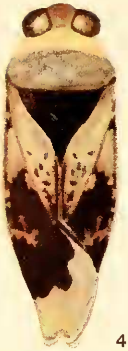
1 *N. insulata* ♀



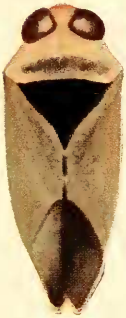
2 *N. ceres* ♂



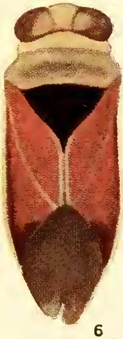
3 *N. ceres* ♀



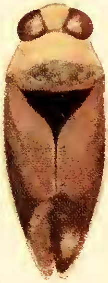
4 *N. kirbyi* ♀



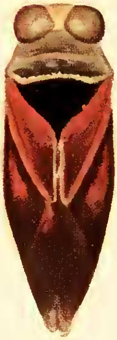
5 *N. lobata* ♀



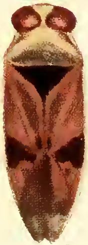
6 *N. compacta* ♀



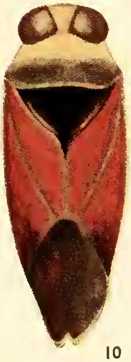
7 *N. melaena* ♂



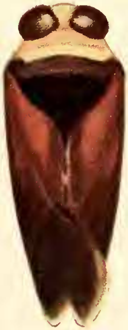
8 *N. mexicana* ♂



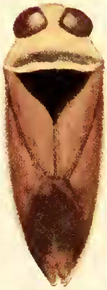
9 *N. uhleri* ♂



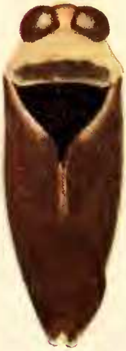
10 *N. lobata* ♀



11 *N. lobata* ♂



12 *N. hoffmanni* ♂



13 *N. lobata* ♂

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Capper Printing Co.

Kathleen Doering
Delineator

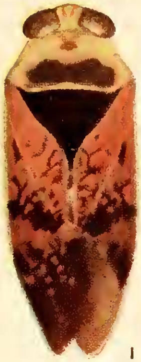
COLOR PLATE IV

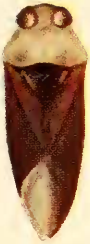
(Magnification approximately × 3)

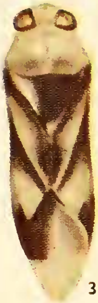
EASTERN HEMISPHERE NOTONECTA

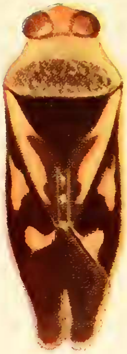
FIGURE

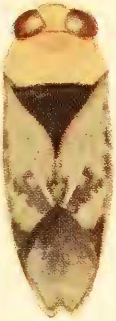
1. *Notonecta montandoni* Kirkaldy. Range: Tibet, south and eastward in China. (See page 37.)
2. *Notonecta handlirschi* Kirkaldy. Range: Known only from West Australia. Only member of the genus known from Australia. (See page 27.)
3. *Notonecta lactitans* Kirkaldy. Range: South Africa, and to date the only member of the genus known south of the Sahara. (See Plate V, figure 12, for the male.) (See page 28.)
4. *Notonecta triguttata* Motschulsky. Range: Japan; may occur in eastern China, but not confirmed by me. (See page 36.)
5. *Notonecta marmorea marmorea.* This is not *N. m. marmorea* Fabr. It comes from Morocco and may be a very pale specimen of *N. viridis mediterranea* Hutchinson, but I really believe that it is *N. viridis viridis* Delcourt. *N. viridis mediterranea* Hutchinson typically has more nearly the color pattern of my *N. viridis kashmiriana.* (Plate V.)
6. *Notonecta obliqua obliqua* Gallén. Range: Northern and middle palæarctic. A well-known European species. (See page 51.)
7. *Notonecta lutea* Müller. Range: Northern Europe. (See page 56.)
8. *Notonecta canariensis* Kirkaldy. Range: Canary Islands. (See page 40.)
9. *Notonecta reuteri* Hungerford. Range: Northern Europe. (See page 59.)
10. *Notonecta glauca* Linnæus. Range: Widely distributed over Europe. (See page 46.)
11. *Notonecta violacea* Kirkaldy. Range: Burma. (See page 45.)

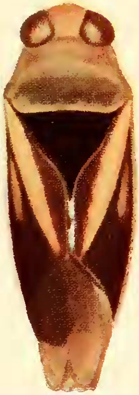

1
N. montandoni ♂

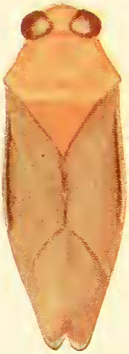

2
N. handlirschi ♂

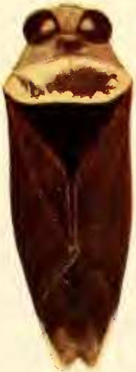

3
N. lactitans ♀

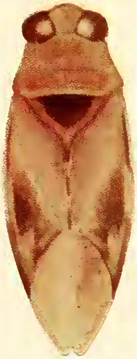

4
N. triguttata ♀

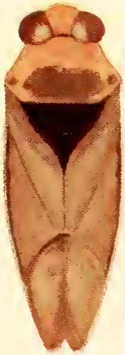

5
N. m. marmorea ♂

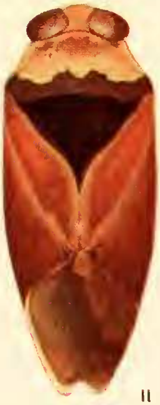

6
N. o. obliqua ♂


N. lutea ♂ 7


N. canariensis ♀ 8


N. reuteri ♂ 9


N. glauca ♂ 10


11
N. violacea ♂

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Delineator

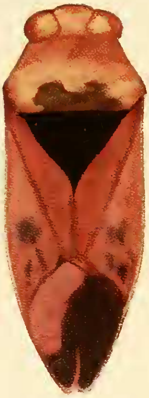
COLOR PLATE V

(Magnification approximately × 3)

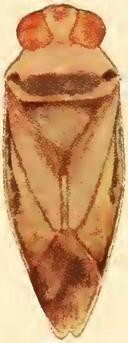
EASTERN HEMISPHERE NOTONECTA

FIGURE

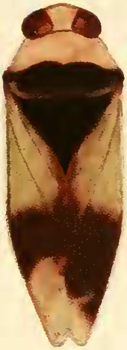
1. *Notonecta arabiensis* Hungerford. Range: Known only from type specimens from Arabia. (See page 44.)
2. *Notonecta pallidula* Poisson. Range: Algeria and Morocco of North Africa. (See page 38.)
3. *Notonecta glauca poissoni* Hungerford. This is one of the specimens mentioned by Kirkaldy on page 421 of his revision. It comes from Mali—Nousky, Erzerum. There are eight specimens of this in Vienna. (See page 49.)
4. *Notonecta amplifica* Kiritshenko. Range: Southeastern Siberia. (See page 55.)
5. *Notonecta obliqua meridionalis* Poisson. Range: Around the Mediterranean. (See page 54.)
6. *Notonecta immediata* Kiritshenko. Range: Eastern Siberia. I cannot distinguish this structurally from *N. triguttata* Motsch. (See page 35.)
7. *Notonecta kiangsis* Kirkaldy. Range: Central and Northern China and Eastern Siberia. (See page 33.)
8. *Notonecta chinensis* Fallou. Range: A common species in China. (See page 31.)
9. *Notonecta kirkaldyi* Martin. Range: Described from Yun-Nan-Nansen. China. (See page 30.)
10. *Notonecta maculata maculata* Fabricius. Range: Western Europe, south from Denmark to North Africa and eastward to Baluchistan.
11. *Notonecta glauca fulva* Fuente. Range: Not well established, but described from Iberian Peninsula. The specimen shown is from Guernsey Island. This form needs further study as to identity and relationships. (See page 50.)
12. *Notonecta lactitans* Kirkaldy. Range: (See Plate IV, figure 3.) This male was called variety *stygica* by Kirkaldy, but is only the male of the above species. (See page 28.)
13. *Notonecta viridis kashmiriana* Hungerford. Range: Kashmir. (See page 65.)
14. *Notonecta m. viridis* Delcourt according to Esaki. I believe should be *N. viridis viridis* Delcourt. Range: England and France. (See page 60.) The specimen here shown is an unusually highly colored specimen from Gravesend, England.



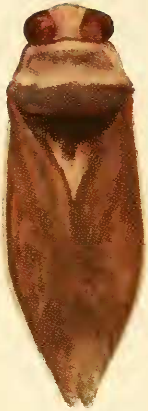
1 *N. arabiensis* ♀



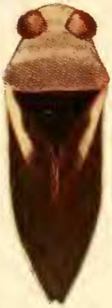
2 *N. pallidula* ♂



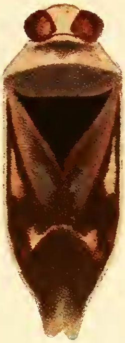
3 *N. glauca var.* ♀



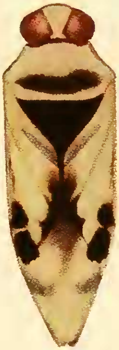
4 *N. amplifica* ♂



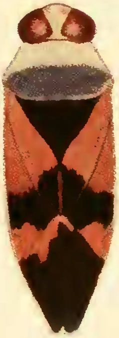
5
N. o. meridionalis ♂



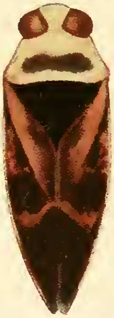
6 *N. immediata* ♀



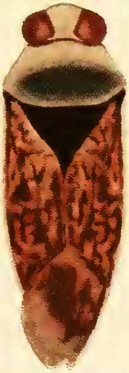
7 *N. kiangsis* ♀



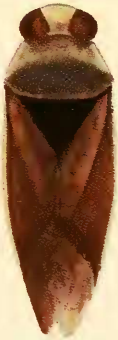
8 *N. chinensis* ♂



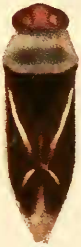
9 *N. kirkaldyi* ♂



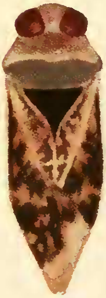
10
N. m. maculata ♀



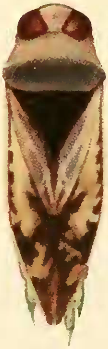
11 *N. m. fulva* ♂



12 *N. lactitans* ♂



13 *N. kashmiriana* ♂



14 *N. m. viridis* ♂

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Kathleen Doering
Delineator

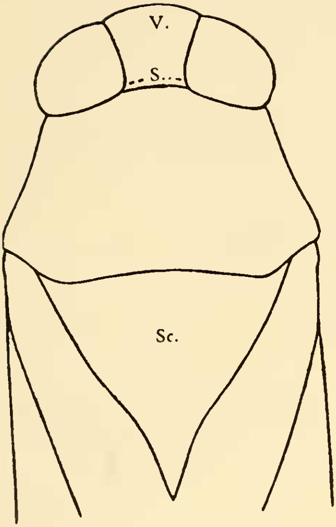
PLATE VI

This plate illustrates the genera of the family Notonectidæ.

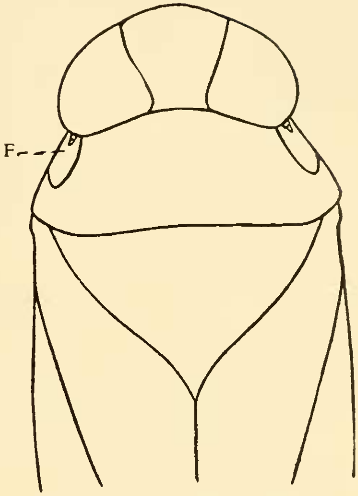
FIGURE

1. Notonecta. Anterior half of dorsum. V = vertex; S = synthlipsis; Sc. = scutellum.
2. Enithares. Anterior half of dorsum. Note that the anterolateral margins of prothorax are foveate, indicated in drawing by F.
3. Nychia. Shows the foveate prothorax.
4. Martarega. Compare with figure 3. The genus Martarega is from Western Hemisphere, while Nychia is found in Africa.
5. Notonecta. Middle femur, showing the anteapical tooth or pointed protuberance, characteristic of the tribe Notonectini.
6. Paranisops. On the left is the form with large scutellum and developed wings; on the right is the form with small scutellum and reduced metathoracic wings. Note the claval orifice just behind the scutellum.
7. Buenoa. Anterior half of dorsum to show the claval orifice (0) just behind the scutellum. In the key this is called the hemelytral commissure pit.

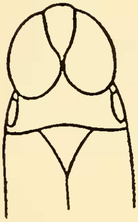
PLATE VI



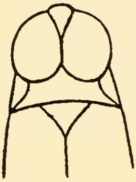
1. Notonecta.



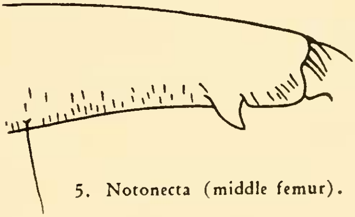
2. Enithares.



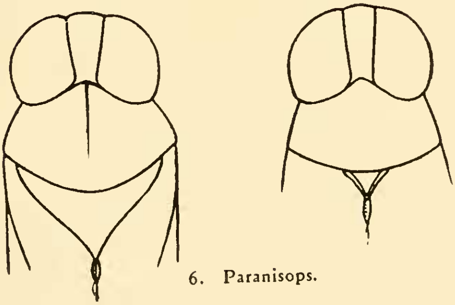
3. Nychia.



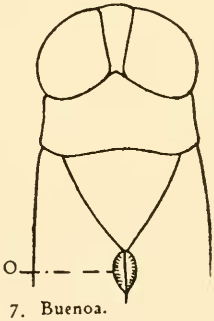
4. Martarega.



5. Notonecta (middle femur).



6. Paranisops.



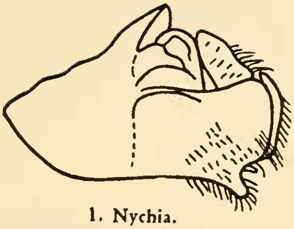
7. Buenoa.

PLATE VII

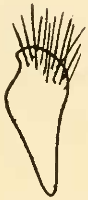
FIGURE

1. Nychia. Genital capsule of male viewed from the left side. Note that the capsule is cleft behind and that the claspers or parameres are unlike on the two sides. (After Hutchinson.)
2. Martarega. Side view of the head, showing the four-segmented antenna; the terminal segment is small. Nychia has lost the terminal segment.
3. Martarega. Genital capsule of the male viewed from the left side. Note that the capsule is cleft behind and that the claspers are unlike. (After Jaczewski.)
4. Buenoa. Genital capsule of the male viewed from left side. The capsule is not cleft behind; the claspers are unlike.
5. Anisops. Left anterior leg of male (inside or anterior view) shows the one-segmented tarsus and stridular area (Str.) on tibia.
6. Buenoa. Right anterior leg of male. Shows the two-segmented tarsus and stridular areas (Str.) on femur and tibia.

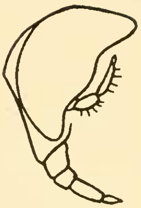
PLATE VII



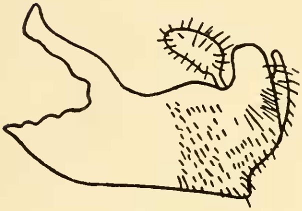
1. Nychia.



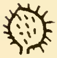
right clasper



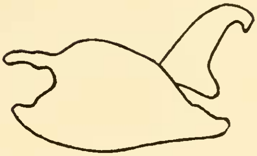
2. Martarega.



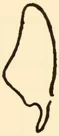
3. Martarega.



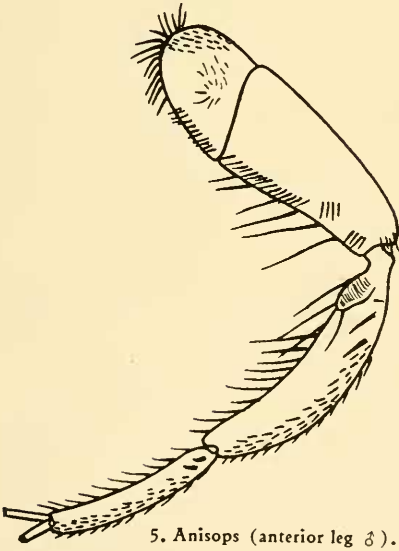
right clasper



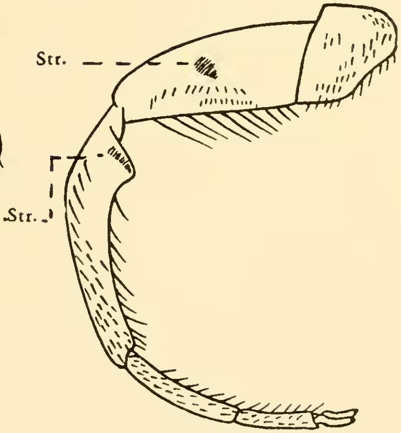
4. Buenoa.



right clasper



5. Anisops (anterior leg ♂).



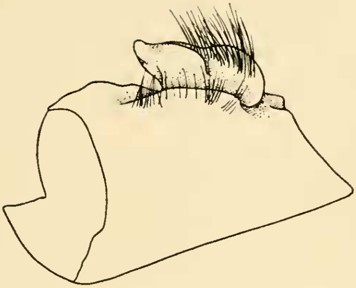
6. Buenoa (anterior leg ♂).

PLATE VIII

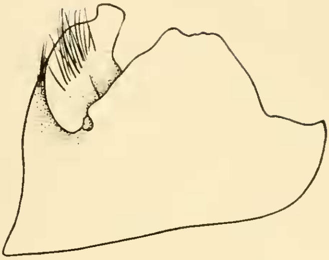
FIGURE

1. *Enithares brasiliensis* Spinola. Genital capsule of male viewed from left side.
2. *Enithares brasiliensis* Spinola. Genital capsule of male viewed from right side. Note the differences in claspers or parameres.
3. *Paranisops inconstans* var. *lutea* Hale. Male genital capsule viewed from left side. The parameres (P) are alike.
4. *Notonecta handlirschi* Kirkaldy (subg. Enitharonecta.) Male genital capsule viewed from the left side. The parameres are alike.
5. Notonecta. Head and pronotum to show the anterior margin of vertex for comparison with figure 8.
6. Buenoa. Genital capsule viewed from right side. R. C. = right clasper L. C. = left clasper.
7. Buenoa. Genital capsule viewed from the left side. Note the differences in the parameres or claspers. L. C. = left clasper. R. C. = right clasper.
8. Notonecta. Head and pronotum—to compare shape with figure 5. (See, also, Plate XVII, figure 4.)
9. *Notonecta lactitans* Kirkaldy (subg. Paranecta.) Genital capsule viewed from the left side.

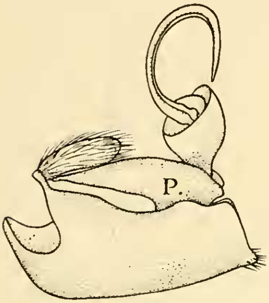
PLATE VIII



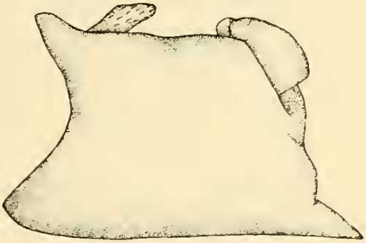
1. Enithares brasiliensis (left side).



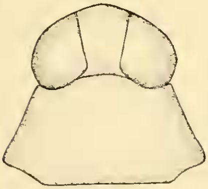
2. Enithares brasiliensis (right side).



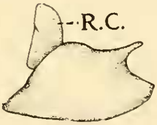
3. Paranisops inconstans var. lutea



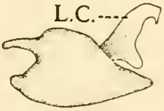
4. N. handlirschi (subg. Enitharonecta).



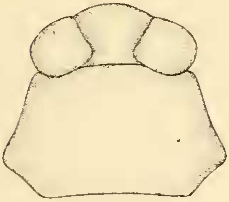
5. Notonecta---head and pronotum.



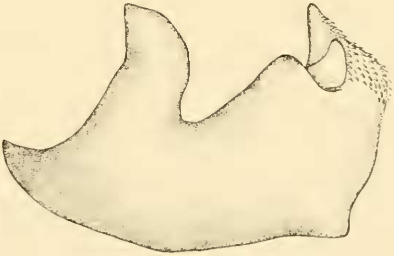
6. Buenoa---(right side).



7. Buenoa---(left side).



8. Notonecta---head and pronotum.



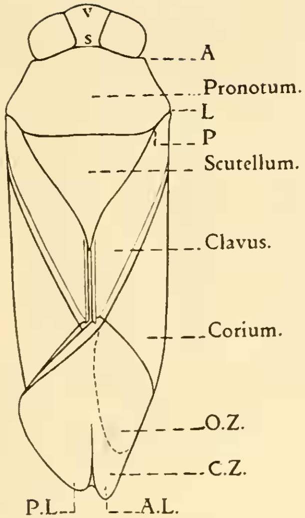
9. N. lactitans (subg. Paranecta).

PLATE IX

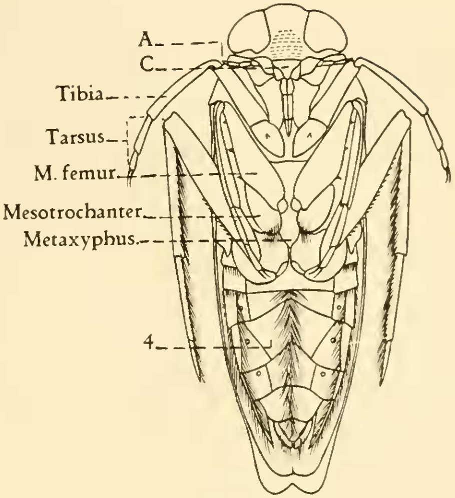
FIGURE

1. Notonecta Dorsal view:
    V = vertex.
    S = synthlipsis.
    A. angle = anterior lateral angle of the pronotum.
    L. angle = lateral angle of pronotum.
    P. angle = posterior angle of pronotum.
    O. Z. = opaque zone of membrane.
    C. Z. = clear zone of membrane.
    A. L. = anterior lobe of membrane.
    P. L. = posterior lobe of membrane.
2. Notonecta. Male, ventral view, showing antenna (A); beak, showing clypeus (C); the three pairs of legs, showing the hook on the anterior trochanters; metaxyphus and fourth abdominal sternite (4.)
3. *N. undulata* Say. Trochanter of male, to show the hook. This hook may be lacking in some species, represented by small proturbance or greatly enlarged as shown in figure 4.
4. *Notonecta shooteri* Uhler. Anterior trochanter of male, to show greatly enlarged hook and basal proturbance.
5. Middle leg of a Notonecta, with rounded trochanter.
6. Trochanter and basal part of femur of a Notonecta, to show spinose mesotrochanter.
7. *Notonecta handlirschi* Kirkaldy. Middle leg, without coxa.
8. *Notonecta lactitans* Kirkaldy. Middle leg.
9. Middle leg of a Notonecta to show the mesotrochanter with angle produced.

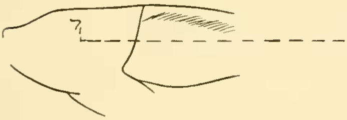
PLATE IX



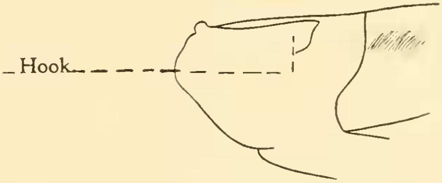
1. Notonecta (dorsum).



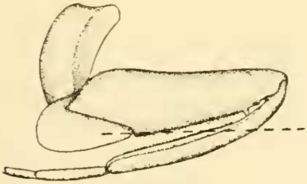
2. Notonecta (venter).



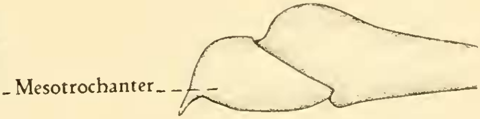
3. N. undulata (male).



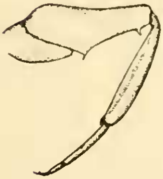
4. N. shooterii (male).



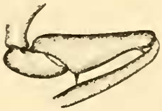
5. Mesotrochanter rounded.



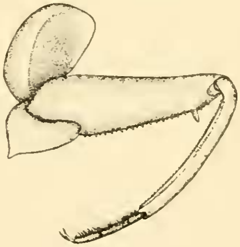
6. Mesotrochanter spinose.



7. N. handlirschi.



8. N. lactitans.



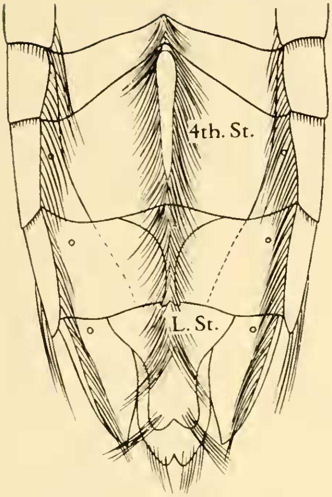
9. Mesotrochanter angle produced.

PLATE X

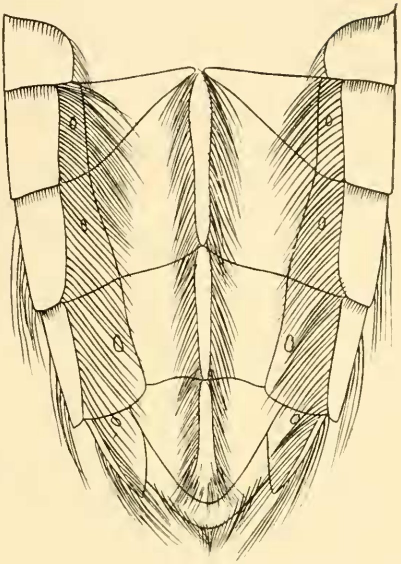
FIGURE

1. *Notonecta lobata* Hungerford. Ventral view of abdomen of female. Note that the carina of the fourth abdominal sternite (4th St.) is bare, that the fifth sternite is narrow and notched at tip and that the last abdominal sternite (L. St.)—typical for *N. mexicana* group—is characteristically different from the others.
2. *Notonecta montezuma* Kirkaldy. Ventral view of abdomen of female. Note that the carina is bare on fourth, fifth and most of sixth sternites. The last sternite is intermediate between the *Notonecta undulata* Say group and the *Notonecta irrorata* Uhler group.
3. *Notonecta undulata* Say. Ventral view of abdomen of female. Note the notch in the distal end of the fifth sternite and the notch in the tip of the last abdominal sternite.
4. *Notonecta irrorata* Uhler. Ventral view of abdomen of female. Note that the last abdominal sternite is large and constricted before the tip, which is not notched.

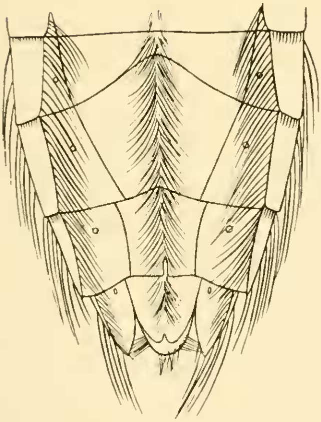
PLATE X



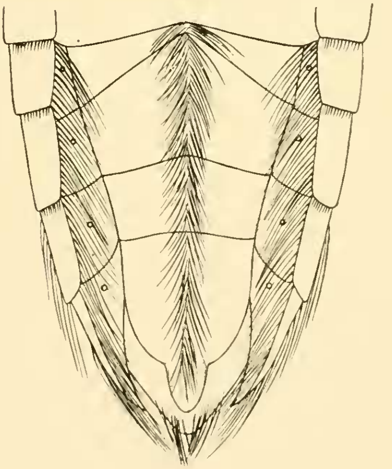
1. N. lobata (abdominal venter, female).



2. N. montezuma (abdominal venter, female)



3. N. undulata (abdominal venter, female).

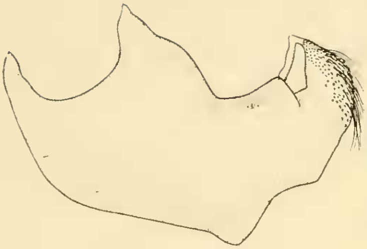


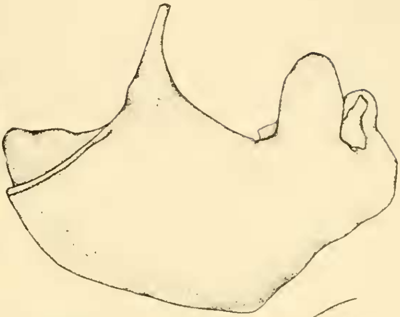
4. N. irrorata (abdominal venter, female)

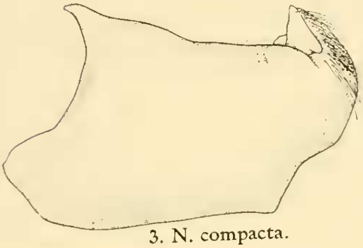
PLATE XI

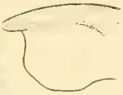
The *Notonecta mexicana* group. Male genital capsules viewed from the left side. Figures 4, 5, 8, and 9 are sketches of the tip of the "internal stay," which in this group is large and strongly sclerotized.

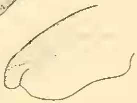
PLATE XI

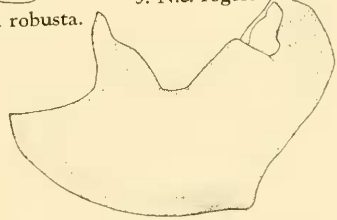

1. N.m. creaseri.

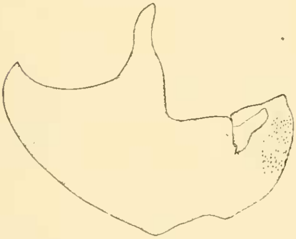

2. N. lobata.

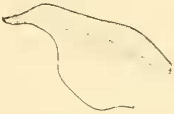

3. N. compacta.

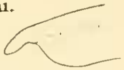

4. N. robusta.

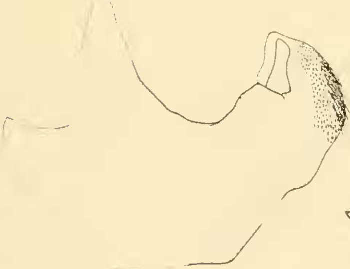

5. N.c. rogersi.


6. N. hoffmanni.


7. N. ceres.


8. N. compacta.


9. N.m. creaseri.


10. N. robusta.

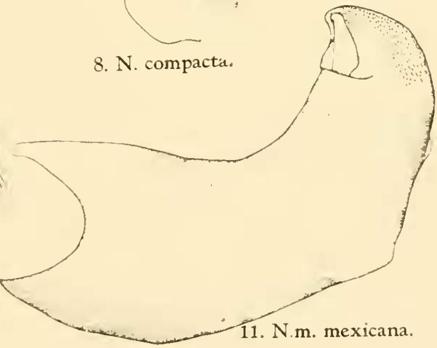
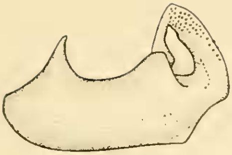

11. N.m. mexicana.

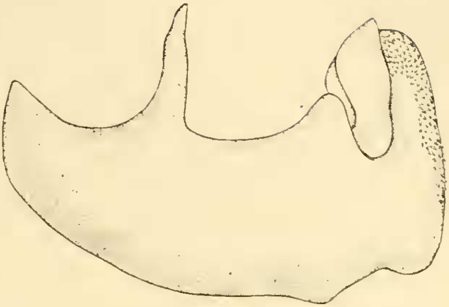
PLATE XII

The male genital capsules of some South American Notonecta. Views from the left side.

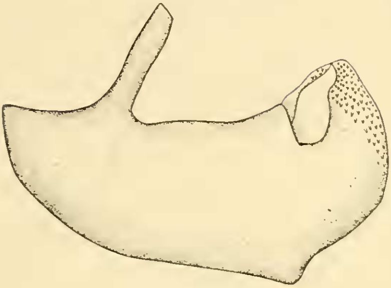
PLATE XII



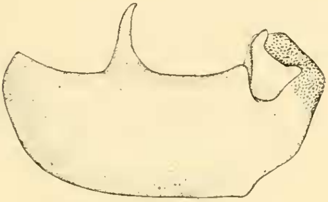
1. N. bifasciata (type).



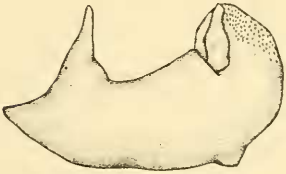
2. N. polystolisma.



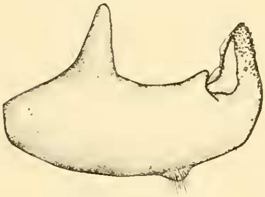
3. N. bicircoidea.



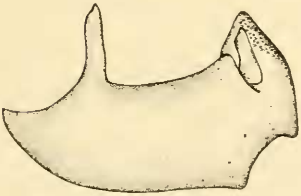
4. N. sellata.



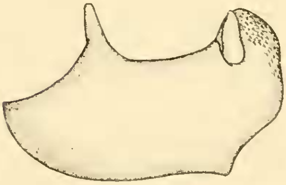
5. N. bicirca.



6. N. minuta.



7. N. disturbata.



8. N. pulchra.